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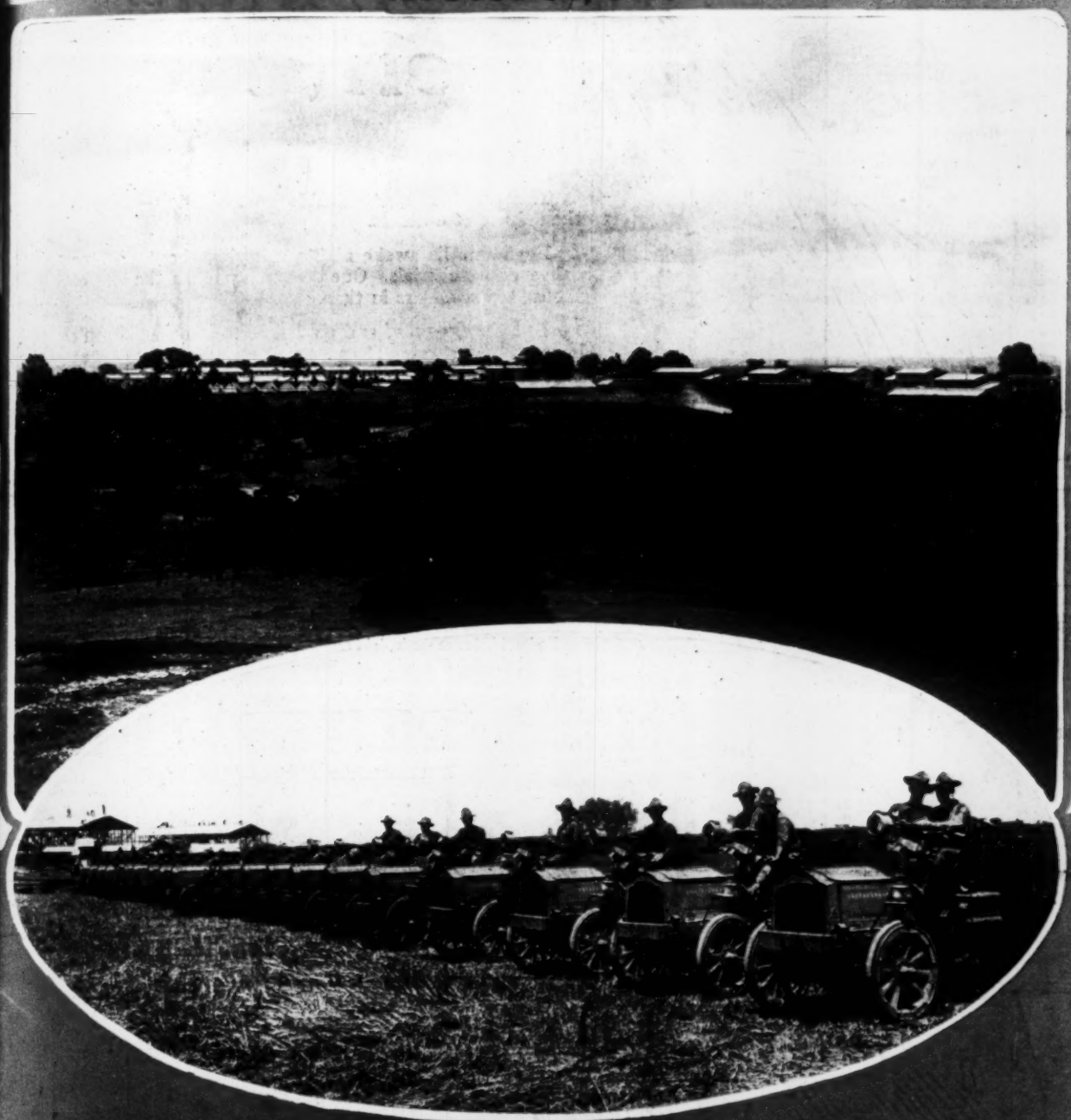
Engineering News-Record

A Consolidation of Engineering News and Engineering Record
McGRAW-HILL PUBLISHING COMPANY, Inc.
AUGUST 30, 1917



Two More Cantonment Articles in This Issue!

One tells about the rush work at Camp Grant, Rockford, Ill. The other describes operations at Camp Taylor, Louisville, Ky., where topographical conditions offered opportunities for city planning. The pictures above are from The Louisville Camp.

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

Cars Are Being Better Loaded

ENCOURAGING reports come from the Railroads' War Board to the effect that shippers are heeding the plea made some weeks ago and are loading cars in such a way as to eliminate waste space. It is estimated that during the month of July the saving so effected was equivalent to 120,000 cars. In other ways, also, the shippers and shippers' associations are coöperating with the railroads. There has been a more or less widespread undercurrent of feeling that better loading was virtually impossible—that human nature and habit could not be thus quickly changed. It is especially fortunate that this has been proved false for the reason that there is every indication that the railroads will have more traffic than ever this fall. We must all still be on the lookout to help "keep the cars moving."

A Weak Provision of a Good Act

OKLAHOMA has taken a long step forward in giving its State Department of Health sanitary control of public water-supplies and sewage disposal. Unfortunately the act outlined on page 393 is weak in that appeal from orders or decisions of the department may be made to county courts. That is, after the department has considered plans for new water-works or sewerage systems, or after it has ordered changes to be made in existing water-works, then the jurisdiction over these highly technical matters may be shifted on appeal from men chosen for their technical knowledge and judgment to the justice of a district court, chosen for quite other reasons—which may be good and sufficient, but do not insure competency to deal with questions of sanitation and public health. Moreover, the appeal also lies from state to county jurisdiction; from a state-wide to a local viewpoint, with all the local influences and prejudices against state control. A better plan prevails in some other states. Where other legislatures have been unwilling to make the state department of health supreme some of them have either provided for endorsement of state department of health orders by the governor and attorney-general or else for arbitration by a board of engineers. The least that the Oklahoma legislature should have done would have been to authorize appeals to the State Supreme Court. Instead, it did next to the worst thing, which would have been to permit a dissatisfied city or company to appeal to the city court or handiest justice of the peace.

The Main Point for the Engineering School Restated

SHALL the young man go to an engineering school? The question is a particularly anxious one this year. We pointed out the situation in these columns on page 338 of our issue of Aug. 23, but there are so many voices speaking eagerly on the subject just now that the main point on which the case must rest needs clear restatement. The truly successful engineering career demands of its votary a love for the work and achievements of the engineer. It demands also a natural aptitude; the creative imagination, the ability to visualize details, the inclination to calculate rather than merely to suggest, a bent for solid practical doing, and instinctive appreciation of natural laws. All these are important, though the love for the work is supreme among them. They are important this year, as they were before. Every standard that the possible engineering student must measure up to is the same as it was two years ago or five or ten years ago. No temporary artificial state exists to modify the basis for choice—or if it should be thought to exist, the wise father or son ought to disregard it. If the future engineer hopes to secure permanent happiness and success, his reason for choosing the profession must be based on grounds that are permanently valid. The world's engineering needs will not be better met or more quickly satisfied if a misguided parent or adviser diverts a good medical student into the mediocrity of a poorly chosen engineering career. More technical students are desired, but they are to be secured by stimulating wider interest—not by enrolling the less fit.

Why Not a Single City Engineering Department?

FEW CITIES centralize their engineering work in a single department. Why? The answer is not hard to find, although it rests on shifty excuses instead of sound reason. The chief excuses are that engineering work has grown in a spasmodic, haphazard way and never been coördinated or consolidated, and that each city department can get better results by having its own engineer. The first excuse only goes to show the urgent need for a change. The second exhibits a narrow viewpoint which puts the good of the parts above and at variance with that of the whole. When now and then a city bestirs itself to reorganize its engineering work, as did Sacramento recently, it seems passing strange to have it create in the same breath an engi-

neering department and an entirely independent street department, the latter with an engineering staff of its own, as outlined on page 297 of our issue of Aug. 16. Barring quite improbable local conditions, there seems to be no reason why the superintendent of streets at Sacramento should not be a deputy city engineer and the field engineers, the draftsmen and other employees be added to the city engineer's staff. The ordinances creating the departments of engineering and of streets have so many good points that it seems a pity that a single department was not created.

Throttling Competition on Sewer Construction

TYING up $8,000,000 of sewer construction to brick alone against the advice of the engineer-commissioner of public works, the city engineer, and a majority of its own sewer committee, as has just been done at Detroit by a 28 to 8 vote of the Common Council, can be explained in only one way: Effective competition is not desired. Citizens and taxpayers of Detroit will do well to insist on opening sewer specifications to concrete, reinforced concrete and segment block, as is done elsewhere and as has been advised by the engineering department of the city and by the Detroit Bureau of Governmental Research, whose clear and forcible statement of this case, reprinted on page 428, makes interesting reading.

Co-operative Purchasing of Road Material by County Boards

WITH vast orders being placed by the Government and others, the wants of the small consumer are likely to be overlooked, and one means of relieving the situation is to combine these small orders so as to make an impressive aggregate that will attract producers. Having in view this object, concerted action in the purchase of materials for county road and bridge work has been decided upon by the county supervisors of Iowa, following the suggestion of Mr. MacDonald, chief engineer of the State Highway Commission, who at a recent meeting of the State Association of County Supervisors strongly advocated adherence to the program for road improvement, in spite of present conditions. He pointed out, however, the difficulties in obtaining the necessary materials when ordered in small lots, and to remedy this proposed that the association form a committee to collect the estimated requirements of individual counties for lumber, steel, cement, sand and gravel, etc. The committee would then locate supplies of these materials and secure bids, which would be submitted to the county officials. Thus the aggregate amount would be large enough to attract the attention of large producers at a distance, and with a six-months allowance for delivery, very reasonable prices should be secured. Further, by placing orders six months in advance the material could be shipped as might be convenient, and then stored. Under present conditions, small shipments are hard to get, and are not unlikely to be diverted to meet emergency orders. Action was at once taken to organize an executive committee composed of one supervisor from each congressional district. This committee is to ascertain from the several counties their requirements for materials for 1918. These estimates will be grouped and bids obtained.

A weak point in the arrangement is the lack of assurance to bidders that material will be purchased in the quantities estimated. The committee will have no authority to place orders or contracts for any county, and actual purchase must be made by the authorities of the several counties. It might be difficult to get action from such a number of counties as to make an aggregate large enough to secure favorable terms. To meet this difficulty, it might be possible for the counties to authorize this committee, or perhaps the State Highway Commission, to purchase and distribute the materials. But local authorities are generally averse to delegating their powers. However, it is significant that the county supervisors so readily appreciated the possibilities of coöperative buying, and it may be that when the time comes to purchase they will back their estimates by actual orders.

Professional Questions Call for Study

YEARS ago engineers lived up to many principles of conduct that now are plainly obsolete. They did not advertise, for one thing. It was unprofessional to make publicity. They never sought a retainer, but waited for the client to come to them. Modern consulting engineers would starve on such a platform—we say platform rather than code, which sounds unchangeable and dogmatic.

Some engineers do starve, or nearly so, by adhering to the old principles. That is a loss to the nation, since their less conservative brethern are often, also, less able; only in business acumen do they excel. To equalize conditions, there is needed a public discussion of questions bearing on professional principles, so that all may come to recognize clearly how they may honorably depart from the rigid rules of older times.

But also, while some engineers are overconservative, others are perhaps overliberal in their principle. They seem to believe in Kipling's "anything for business, an' we're growing old!" Here again the open discussion of professional questions has a chance to prove helpful.

Attempts have been made by one or two engineering societies to bring about discussion and adjudication of such questions. A most promising method for achieving the desired result! Yet it has not proved effective. Why? Perhaps those who know how the executive affairs of a large society must be handled can supply an explanation. But we have little need of learning why, in the face of the fact that no effective result has been reached. Professional questions are still as open

and unsettled as ever, in spite of the work of societies and committees.

A prime difficulty in the matter is that two kinds of questions come up. Some are concerned with expediency alone—the question of whether safe and sound relations between engineer, client and public are maintained under the particular procedure in question. Others, however, involve general considerations of probity; for example, the question whether a certain action does not amount to false pretense, or to bad faith with a brother engineer, possibly.

Everybody is competent to recognize the right way in matters of plain honesty. Certainly every engineer can see straight in this respect. So we may pass by the cases involving a clean-cut moral issue, for they involve no particular question. They may be useful to illustrate complications arising in practice, but that is all.

Those cases in which expediency is the crucial question are of widest interest, however. Few engineers can avoid being involved now and then in a case of this kind, and in every instance they experience doubt and uncertainty. They would be helped, we believe, by contemplating numerous other cases—by having the opportunity to study real questions arising in the experience of other engineers.

Engineering News-Record is willing to open its columns to brief, impersonal statements of such cases. It can offer the aid of publicity to bring about the needed mutual enlightenment. Its editors will undertake to receive full statements of cases involving questions as to professional propriety or good practice, and to prepare from each an abstracted impersonal statement, bare of names and localities, but preserving the essence of the issue.

To this end we request that readers who have encountered in their recent experience questions regarding professional conduct communicate with us and thus assist in bringing before their colleagues a collection of practical problems on which each may base his own study of the subject and out of which he may draw his own rules of professional ethics.

Continued Construction the Safe Course

OUR development has never been ahead of the needs of the times. What we build is that which the moment's need calls forth; in neither service nor production is a reserve of capacity ever provided. Municipal and state public works—the public's household equipment—are always below the level of physical needs. In exactly the same way manufacturing facilities, while up to a normal market, ever remain below maximum demand. Railways, too, are adequate only for moderate traffic and become congested at the first approach of a heavy crop or of any abnormal traffic demand.

Our country grows steadily. We build all the time, without interruption, more works and factories, more railway track and terminals, more cars and more ships. We must build them for the needs of yesterday and today. Capital and time have never been available to build for tomorrow.

This is the *normal* need for construction—to keep up with growth, to make up deficiencies as they develop. In this war year of 1917, however, there is vastly intensified growth and need for growth. We are speeding up in every department of American life. We are striving for both greater efficiency and greater capacity: the use of more hands, more machines, more buildings and more brains than ever before. Such are the facts at the present moment and such will they be for a long time to come. The situation calls imperatively for more construction.

To repeat: We have never built ahead, but always for the needs of the day alone. Yet now under the emergency stress of an unprecedented period, many men throughout the country ask the question, "Can we not get along for a time on the facilities provided in the past, on the building and construction that we did yesterday?" In the opinion of *Engineering News-Record*, the answer is an emphatic No!

We are at the beginning of a hard job. Our national muscles are already taking the strain, and they have a long day of steady work before them. The body that supports them must furnish more nourishment and strength. Every fiber must do its part and must be fit for its part. But no undeveloped or atrophied organ can do its proper work.

In the past a city that was backward, that temporized in public improvements and provided its citizens with less efficient living facilities than they needed, did not bring any vital loss to the country; the city itself stayed back in the march of progress, but the nation as a whole was not affected. Today the bad streets that retard and stop traffic and the poor water and sewer systems that produce sickness mean just so much of a check to the nation's efforts.

Out in the dry West, where the irrigation water provided by wise foresight has raised heavy crops, food supplies in quantities may become a loss because the growing districts are not tied into the nation's life by enough railway lines and cars. More broad-gage planning is needed to assure that next year this particular organ of our body politic will not be isolated from the general blood current. Engineers must plan and build, or the farmers next year will not be encouraged to plant beyond a minimum.

Local and particular instances may be multiplied indefinitely. But every one of them merely reflects the broad and universal need throughout the country for continued and active work by the engineer and the constructor. Brains and hands and capital must be put into the work of construction in greater quantity and with greater efficiency than ever before. Any step that tends to check or paralyze the country's construction activities is a serious mistake that will not easily be forgiven in years to come.

Commandeer Organizations for Illinois Cantonment Construction

Rockford Camp Progresses Rapidly from Start—Ideal Location on Quick-Draining Glacial Drift—Contractor's Force of 6000 Housed and Fed in Permanent Barracks

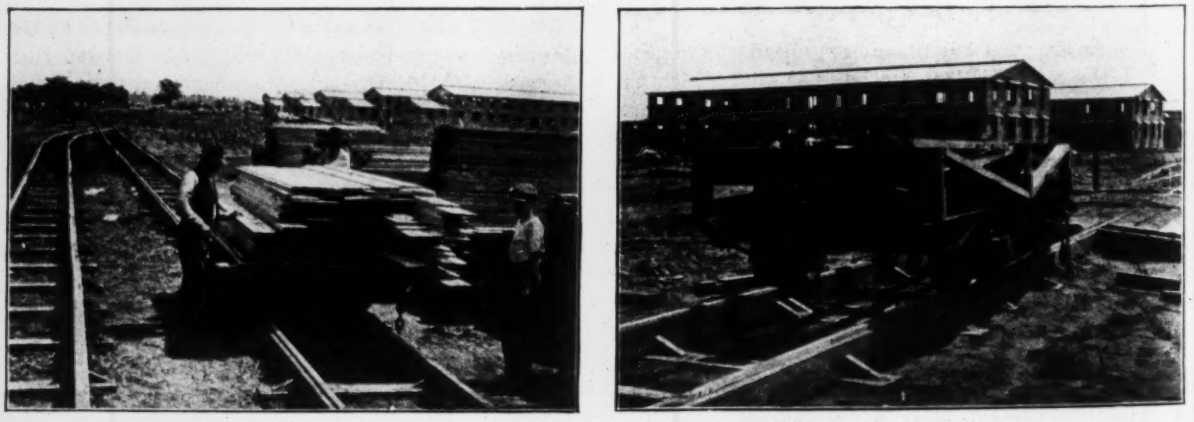
By W. W. DeBerard
Western Editor, "Engineering News-Record"

THIRTY TO FIFTY CARS OF LUMBER "MELT" AWAY EVERY DAY, SO NO LARGE AMOUNT IS PILED

ONLY by commandeering men with organizations could the rapid progress being made on the cantonment for the Eleventh National Army Division at Rockford, Ill., be accomplished. All of the larger activities of this future city to train 38,000 men are in charge of men who bring their whole organizations with them. The single individual does not count for much when millions must be spent in a few weeks. Under the commanding officer are the military, supervising engineers, sanitary, constructing and auditing divisions. As yet the military units are comparatively small in number, a company of engineers assisting the consulting staff, one of motor trucks assisting the contractor in handling material and four of infantry for guarding the grounds, mainly against fire hazard. The supervising engineers have a staff of 40 men who are attempting to keep the layout at least a day ahead of the construction forces. Working with the supervising staff is the consulting architect, a practical city-planner. The contractor's staff consists of a skeleton of his own organization augmented by men selected from railways and other large corporations. The auditing department for the Government is supplied by the American Audit Co. to check in and out all men, materials and equipment used by the contractor.

In actual construction the cantonment has little of interest to engineers, for tried designs only are permitted. The story lies almost entirely in method of procedure and ways of handling material. Both are largely dependent upon organization.

Located on the terminal glacial moraine, Camp Grant, as it is officially named, lies 6 miles south of Rockford on the outside of a sharp bend of the Rock River. It is a rich, sandy farm-land plateau, 35 ft. above the river,

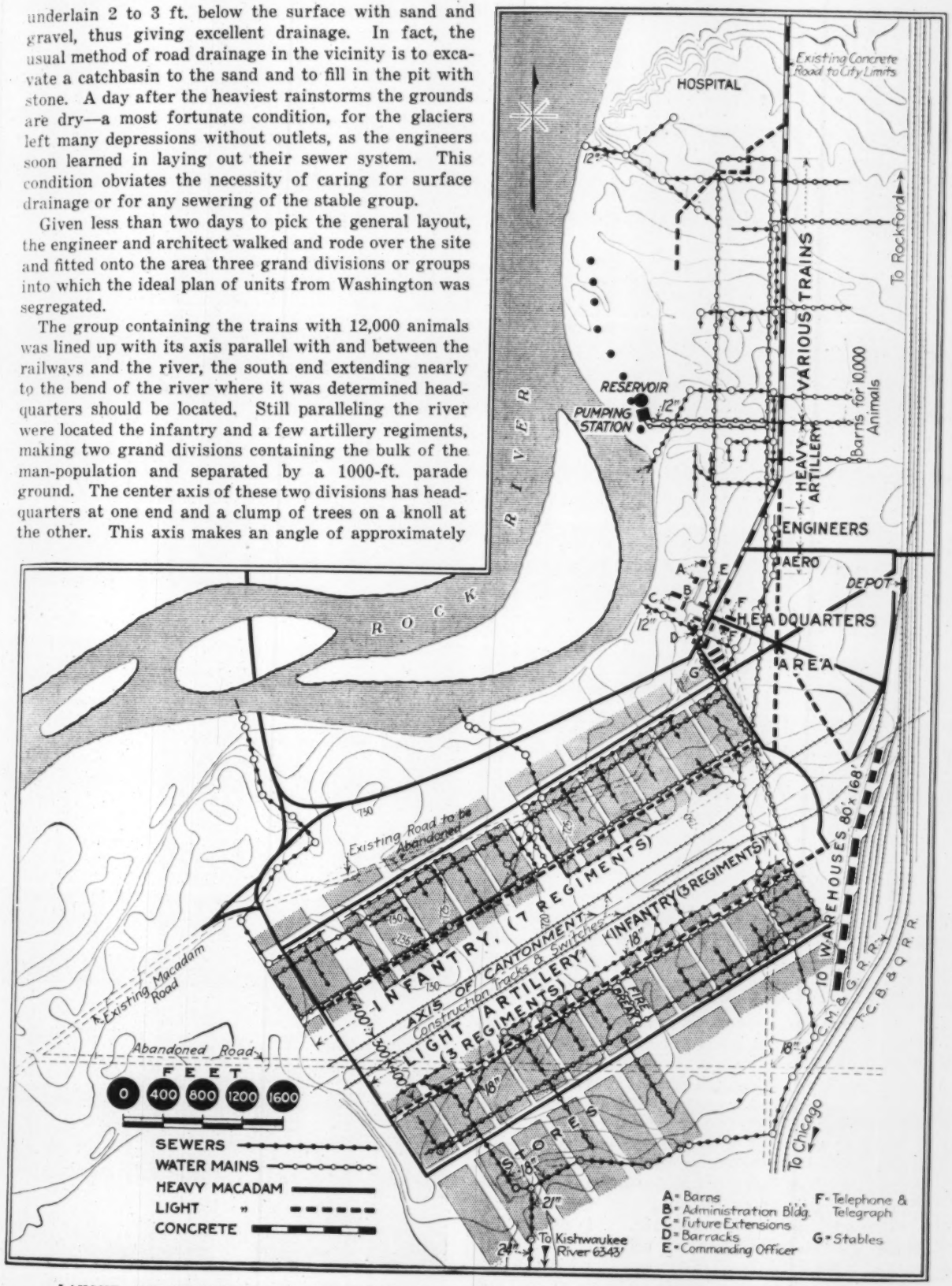


WOODEN TRACKS FOR USE IN WET WEATHER LEAD BACK TO THE INDIVIDUAL UNITS

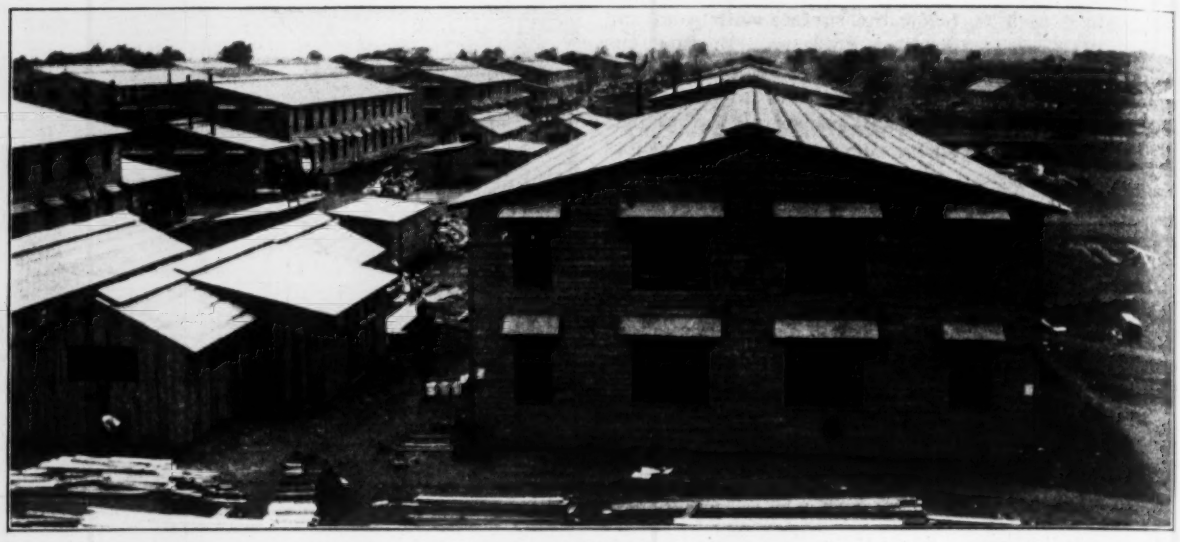
underlain 2 to 3 ft. below the surface with sand and gravel, thus giving excellent drainage. In fact, the usual method of road drainage in the vicinity is to excavate a catchbasin to the sand and to fill in the pit with stone. A day after the heaviest rainstorms the grounds are dry—a most fortunate condition, for the glaciers left many depressions without outlets, as the engineers soon learned in laying out their sewer system. This condition obviates the necessity of caring for surface drainage or for any sewering of the stable group.

Given less than two days to pick the general layout, the engineer and architect walked and rode over the site and fitted onto the area three grand divisions or groups into which the ideal plan of units from Washington was segregated.

The group containing the trains with 12,000 animals was lined up with its axis parallel with and between the railways and the river, the south end extending nearly to the bend of the river where it was determined headquarters should be located. Still paralleling the river were located the infantry and a few artillery regiments, making two grand divisions containing the bulk of the man-population and separated by a 1000-ft. parade ground. The center axis of these two divisions has headquarters at one end and a clump of trees on a knoll at the other. This axis makes an angle of approximately



LAYOUT AND UTILITIES AT THE ROCKFORD CANTONMENT, SHOWING WORKHOUSES, TRACKS AND CONSTRUCTION TRACKS



THREE ROWS OF BARRACKS FOUR DEEP MAKE AN INFANTRY REGIMENTAL UNIT

120 deg. with that of the first division. A fringe of trees approximately ¼ mile wide lines the river bank. This has been preserved for park purposes, and practically all trees surrounding farmhouses will be saved by slight shifting of structures without breaking up the general orderly lines of the buildings. The more desirable farmhouses will be utilized for officers' quarters. Haphazard placing of buildings to obscure desirable outlooks down streets between units has been avoided if possible, and many other similar schemes of the city-planner to influence consciously or subconsciously the mind of the soldier-to-be have been kept in mind. Headquarters with its apple-orchard avenue of approach to the general's mansion and numerous other well-placed axes on the headquarters layout require constant attention on the ground and frequent consultation with the engineers.

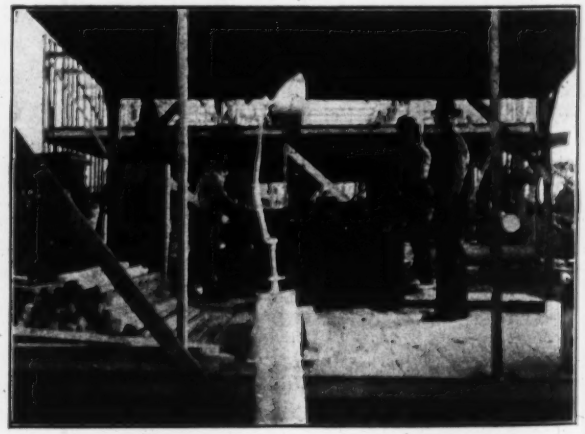
Water-Supply Problem

No great difficulties attend the securing of a deep-well water-supply, for water-bearing St. Peter's limestone is reached at 400 ft. Eight wells are going in on a flat near the river. Three drilling outfits are at work, and six will be employed. Three air compressors of 2000 cu.ft. per min. capacity will lift the water to a surface concrete reservoir of 150,000-gal. capacity. Air was chosen because of its flexibility, should sufficient water be found in the gravel at 200 ft., or should it be found necessary to increase the depth of the wells beyond 400 ft. The plan is to go down only so far as necessary to get the required amounts. Possibly four or five wells will be sufficient, but all are connected to the same air line. There are two Alberger centrifugal pumps of 1000 gal. per min. capacity, and two American Well Works centrifugal pumps of 1000 and 750 gal. capacity, all motor driven. These will pump into the distribution system on which, near the center of consumption, is being erected a 250,000-gal. steel tank purchased from the Chicago Bridge and Iron Works. It is 150 ft. high. There was an alternative of using three separate wooden tanks until the steel one was found in stock.

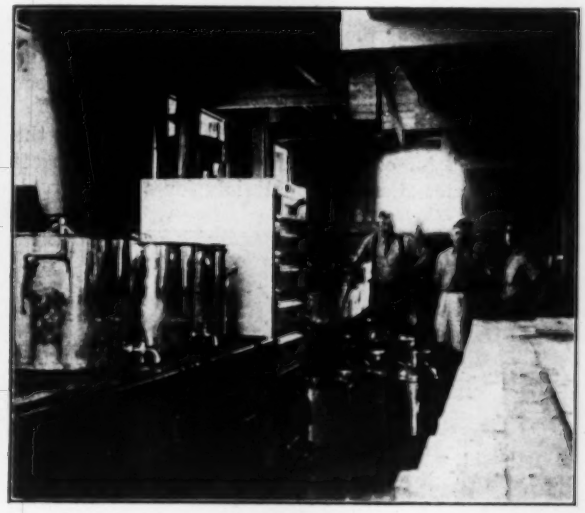
The distribution system consists of loops around each of the grand divisions with 150 hydrants at 500-ft. intervals. Each regimental unit is supplied according to standard plans from Washington. In fact, no departure is being made from standards, and it is the commanding officer's creed to initiate no innovations in any of the work. No short-cuts or "stunts" are being tried for the first time. No man with a new-fangled machine, no matter how plausible, gets any satisfaction at Camp Grant.

Sewer System Made Shallow To Fit Machined Trenches

Not often is a 23-mile sewer system revamped overnight because on trial it is found that the deep trenches cave in. That is what happened at Camp Grant, for on trial it was found that a long cut of about 2000 ft. with maximum cut of 13 ft. caved badly when the depth exceeded 7 ft. The original plan was to collect everything into one sewer and carry the sewage away from the Rock River watershed into the watershed of the Kishwaukee River, which joins the former about 1 mile below camp, to an outlet at the junction of the two rivers. This would conserve the Kishwaukee for bathing. After it was found that the cut could not be made without



FIVE GASOLINE-DRIVEN SAWS ACCOMPANYING EACH UNIT WORK AT NIGHT CUTTING TO TEMPLETS



FOUR HUNDRED ARE FED FROM EACH ARMY BARRACK KITCHEN

elaborate bracing, all grades were raised and five additional outlets provided directly into the Rock River opposite camp. As this stream receives all the sewage of Rockford, its use for domestic purposes will be prohibited anyway.

With the shallower cutting the material is an ideal trench-machine job, and already one Austin outfit has made a record of 1700 ft. per 9-hour day. The schedule calls for 2500 ft. per day for three machines. On July 18, two miles of trench had been opened, 13 cars of pipe had just been unloaded, and 70 of the 150 cars required were on the way. Unloading proceeds at night, Carbic flares furnishing the light.

Local Materials for Roads

Of the 22 miles of road within the reservation, 7½ miles will be heavy macadam 18 ft. wide, 8 in. thick at the center and 6 in. at the sides; 3½ miles will be graveled from a pit on the reservation, and the remaining mileage will be graded earth roads which can be maintained in good condition with a small amount of care. The gravel is fine and needs a little binder clay.

For the distribution of the 332 cars of stone, 1½-ton Velie army trucks will be tried, although the bodies are stationary and the time element in unloading may make their use infeasible. However, the captain in charge of the motor-truck company claims that loads can be shoveled off in 5 min. The engineers contemplate building an inverted hopper as a false bottom to facilitate unloading. On the natural farm lands the trucks mire down in wet weather, making their use impracticable for about a day after a storm.

The county will open, Aug. 1, a concrete road leading from the city limits to the camp. The city is rushing to completion by the same date a strip 18 ft. wide of monolithic brick nine blocks long, to connect with existing hard pavements. A detour at present over several miles of earth road has prevented little trucking to camp from town. This second road will be concreted to the city limits as soon as the main road (Kishwaukee) is opened. A third proposed route is to utilize a macadam road down the opposite side of the river and to bridge it at the camp site by a ponton until the county can build a steel structure. Capt. C. C. Saner, of Company A, Illinois Engineers, is investigating the foundations for the steel structure and will build the ponton if authorized.

Transportation Problem Big

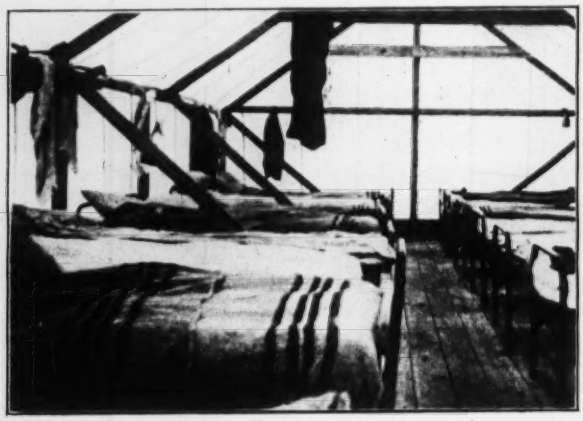
With the building operations scattered over an area more than 2½ miles in length, one of the first things to do was to build a railroad to serve each of the grand divisions. The Chicago, Burlington & Quincy R.R. Co. detailed C. J. McCarthy, division engineer of the Rockford division, to lay out and build from plans decided upon on the grounds by the commanding officer, contractor and himself, for the railway company. In general, the scheme consists of main tracks with switches in front of each grand division, but far enough away so that the 25,000,000 ft. of lumber and other materials might be piled in front of each of the various units and still leave sufficient space so that the fire hazard would be a minimum. A fire-department chief, four men and apparatus have been furnished by the City of Rockford, to still further protect the lumber and completed buildings.

So far the lumber has "melted" away so fast under the contractor's forces that no respectable piles are noted in front of any particular unit. The auditor's report on July 25 shows that the following quantities were handled less than four weeks from the beginning of active construction: Carloads of lumber unloaded (July 25), 54; total to date, 674; en route, 263; cars of miscellaneous material unloaded (July 25), 10; total to date, 248. No one of the units was entirely complete, but 36 barracks were substantially so, and work was under way on as many more. The railroad layout is shown in one of the drawings. Some of the curves otherwise unexplainable are due to topography, as no cuts or fills were feasible on such short notice.

Transportation of material back to the building sites from the switches is by army motor trucks, by teams and by improvised lorry cars drawn by teams over wood tracks. The latter method is not much used except immediately after rainstorms, when the teams and trucks mire down, but have exceptional value because of the unusual number of rainstorms during the early opera-

tions. Only a portion of the 33 trucks are used at this short-haul work, as they are reserved as much as possible for the long hauls, such as delivering pipe and road material. Teams do the greater portion of the lumber hauling.

The contractor has erected large warehouses along the switch tracks for cement, plumbing supplies, electrical equipment, etc. Complete materials for a single regimental unit are ordered separately and unloaded opposite the unit where they are to be utilized, so that no great piles are anywhere visible.



IRON COTS, MATTRESSES AND BLANKETS ARE FURNISHED THE MEN WHO MOVED FROM TENTS INTO BARRACKS AS FAST AS THE LATTER WERE BUILT

While the troops will not arrive until Sept. 1, the quartermaster expects to begin storing immense quantities on Aug. 1. For this reason, work is being pushed on ten 80 x 168-ft. warehouses on a site adjacent to the existing railway tracks where there will be at least six team tracks and main track with spurs to each.

Contractor's Organization

Several executive officers of the contractors are on the ground continuously from 12 to 20 hours per day. In the construction division under them are a general superintendent and an assistant. Under these two men are field superintendents in direct charge of the building operations of a single regimental unit. The number of these men will be increased to keep up with the pace set by the railroads in getting material on the ground. Each unit is working under a different-colored flag for easy identification, and rivalry as to breaking schedule records is fostered down the line in each unit organization. Each superintendent has a general foreman in charge of several buildings, and each building has one or more carpenter foremen. For the utilities, such as water mains, water-supply, sewers, electrical installations and plumbing, there are superintendents in addition to the building superintendents in charge reporting to the general superintendent. Each of these divisions has its own estimating staff in the office and distributing staff in the field. The superintendents may consult these men directly in getting information as to layouts, materials, checking bills and shortages, without going to the general superintendent. A head estimator and assistants check all division estimators' figures and put the bills of materials in shape for final ordering—all of which goes through a chief clerk and then to the buyers. The Government auditors keep track of t[he] and material and handle the accounts. The contrac[tor] has a bookkeeping department, for he must actually p[ay] the men and material bills from payrolls and vouch[ers] received from the Government auditors.

A camp superintendent under the chief clerk hous[es] and feeds the force, which will be increased ultimat[ely] to 8000 just as soon as the permanent barracks a[re] completed for them, contractor's tents and temporary shacks being provided only for the first 700. For each barrack there is a clerk to check the 400 men in and out, a chief clerk, assistants and waiters. All the people on the work—laborers, visitors and officials—have brass checks issued to them. Each man carries a disk indicating to what barrack he is assigned in order to avoid confusion, and four times a day they must give the number to the auditor's force, small portable checkhouses being provided at suitable intervals.

An inspection of the half-dozen dining halls in operation July 20, when 2500 men were fed, and a sample of the meals indicate that the contractor will lose no men on this account. In fact, Chicago restaurants looked decidedly uninteresting after a "square" in camp. Iron cots, mattresses, and blankets spaced much as they will be for the soldiers, are placed on the second floors above the mess halls.

The rapidity of increase in the contractor's operations the first week is shown by the number of men at work beginning July 1: 32, 425, 762, 727, 1103, 1230 and 1175. On July 17 there were 2703, on July 19, 2860 and on July 25, 5800. Until this date men have drifted in because of newspaper publicity.

The wage scale and condition as to overtime prevalent in the vicinity are paid.

Sanitation Handled by Medical Corps, U. S. A.

Arriving on the ground 10 days after the building operations began, Capt. H. C. Mitchie inaugurated immediately the regular army precautions for handling camps. He has a division of 50 men constructing latrines in advance of building construction, a division of disposal and a fly squad. Urine is collected in garbage cans, dumped into tank wagons and discharged into the river below camp. Another wagon group limes and burns latrine contents daily. The fly squad, in addition to

continual inspection, uses swatters, fly paper, traps and chemicals to reduce to a minimum any chance of infection by the fly route. About 20 bbl. of garbage are collected daily by La Forge & Son, who operate a reduction plant in Rockford. Combustible material is burned by the fire department.

PERSONNEL

Maj. D. H. Sawyer, formerly a member of Sawyer Brothers, consulting engineers, of Spokane and Seattle, Wash., is constructing quartermaster. Detailed to him from Company A, Illinois Engineers, are Lieut. D. A. Tomlinson as adjutant and Lieut. W. H. Dean as chief draftsman. J. M. Moloney, civil engineer, has charge of all building operations for the quartermaster.

Alvord & Burdick are the supervising engineers for sewers, water-supply and roads. They have A. T. Luce in charge of the fieldwork and D. H. Maxwell in charge of the office work. E. H. Bennett, of the Chicago City Plan Commission, is the consulting architect, assisted by C. E. Howard, of Syracuse, N. Y.

The Bates & Rogers Construction Co. has the contract and has put its whole organization at the disposal of the Government. E. S. Holland and E. P. Lenahan, vice-presidents, are on the work continually. F. L. Copeland and E. S. Whitney are general superintendents. In spite of the rapidity with which the camp force was organized and work started, the contractor's organization has been working smoothly and effectively, and much credit is given to it for the speed of progress.

French Military Roads Given Excessive Crown When Reconstructed

In reconstructing French roads for military purposes, where they have not been damaged by war operations, it is sometimes possible to afford considerable relief to traffic by widening them. In carrying on the work in mountainous sections subject to heavy rainfall, where it is necessary to have the surface dry out as quickly as possible, the roads are sometimes given considerable crown, to shed the water into the ditches. This crown causes much complaint from drivers, for it results in considerable skidding, but the transportation authorities believe it is better to dry off the road promptly, even at the loss of a few trucks by accident, than to have it stay soft, damp and easily cut up for some time after each rainfall. Another interesting feature in the improvement of these roads is seen at some of the little hamlets where the roadway is confined between houses, so that widening of it is impracticable. Here detours are built around the hamlets, sometimes narrow so as to take only the traffic passing one way, and sometimes wide enough for traffic in both directions. There are some of these narrow roads which it is impracticable to widen rapidly, and in such cases traffic in one direction is routed over them and a new road built to accommodate the traffic in the other direction. It has also been necessary in places where narrow bridges would cause a congestion of traffic on a wide road, to widen the bridge or build another beside it. Some of these bridges are by no means so strong as might be desired for concentrated military traffic and the ways in which they are cribbed and braced include every expedient engineering ingenuity can suggest.

Oklahoma Steps Forward

Water-Works and Sewerage Plans Must Be Approved by State Board of Health Before Letting Contracts

PROGRESSIVE legislation vesting the Oklahoma State Board of Health with the sanitary control of water-supply and sewerage systems was enacted by the last session of the legislature of that state. After the act goes into effect (June 30, 1918) no contracts for new water-works or sewerage systems or for changes in or extensions to old systems of either class, except extensions of water-distribution pipe, can be made without filing plans with the State Board of Health and getting the approval of that body. The board is also given power to order changes in water-supply and sewerage systems necessary for the protection of public health.

Violations of the provisions of the act are made misdemeanors and are subject to penalties of from $25 to $50. If water is supplied or sewage discharged without the required permit, then each day of violation constitutes a separate offense. In case a contract is let for water-works improvements without a permit from the State Board of Health or in case any construction work of any sort for supplying water is done without a permit having been issued by the State Board of Health, the fine will not be less than $500 for each offense.

MUST FILE PLANS

Every owner of existing public water-supplies is required to file with the State Board of Health a certified copy of the plans and surveys of the works and a description of the source from which the water-supply is taken. Every owner of a "sanitary sewer system" must file with the board "a report of such system," giving such information as the board may require.

Complaints regarding the sanitary quality of any water supplied to the public for domestic or drinking purposes may be made by the mayor of any city, the president or chairman of any board of trustees of any incorporated town, by any county officer, or by any local board of health. It will then be the duty of the State Board of Health to investigate the character of the water-supply complained of and if the board has reason to believe that the water is dangerous to health it may order "such change in the source or sources of said water-supply, or in the manner of storage, purification of treatment of said supply before delivered to the consumer, or both, as may be necessary in its judgment to safeguard the public health." The owners of any such supply under complaint and investigation must supply whatever information is demanded by the State Board of Health, and must comply with the order of the board when issued.

SCOPE OF ACT

The act does not apply to the discharge of sewage from sewerage systems in operation and discharging sewage into the waters of the state on July 1, 1915, but the act will apply to extensions to such systems after that date and it will prohibit "the discharge of any sewage which upon investigation by the State Board of Health, as hereinafter provided, shall be found to be polluting the waters of the state in a manner prejudicial

to the health of the inhabitants thereof." The subsequent provision mentioned above provides for investigation of complaints of sewage pollution by municipal and county authorities in the same general way as has already been outlined for investigations in regard to the unsanitary character of water-supplies. After investigations of such complaints, or after investigations made on its own initiative, by the State Board of Health, if the board concludes that sewage discharge is prejudicial to the public health, changes deemed necessary by the board in the interest of public health may be ordered.

Owners of sewerage systems may apply to the State Board of Health for permits to discharge sewage into any of the waters of the state and the board may give such permits when it is the unanimous opinion of the board "that the general interest of the public health would be subserved thereby." Such permits must stipulate the conditions under which the discharge may be permitted, the time during which the discharge may be made, and the permits are subject to modification and revocation by the board at any time after investigation and hearing, provided notice is given to all parties and interests. No permit shall be granted under this provision of the act to anyone who has failed to file with the board the required report already mentioned.

The act defines sewage as "any substance that contains any discharges from the bodies of human beings or animals, or chemical or other wastes from domestic manufacturing or other forms of industry."

How Appeals Are Handled

Appeals from orders of the State Board of Health disapproving plans for water-works or for sewerage or sewage disposal, or ordering changes in such plans, and also appeals from the order of the board to make changes in existing water-supplies, may be made to the district court of the county in which the water-works or sewerage system is located whenever the owners of any such water-works or sewerage system believe that the action of the board is "illegal, or unjust, or unreasonable." Such appeals must be taken within 30 days after the order is made. The court must hear such appeals promptly and must "render a decision approving, setting aside, or modifying said order, or fixing the terms upon which the said permit shall be granted, and stating the reasons therefor."

The State Engineer is required by the act to delegate one of his assistants to help the State Board of Health in making any necessary investigations required by the act, as well as to assist in passing upon plans submitted for approval.

Dr. John W. Duke is health commissioner and Dr. C. J. Kendle is assistant health commissioner of Oklahoma, with offices at Guthrie.

A Three-Shift Water Laboratory

To secure better control of the operations of the water-purification works of Toledo, Ohio, the laboratories were operated throughout the 24 hours last year, says R. W. Furman, chemist in charge, in his report for 1916. Samples for chemical analysis were taken every two hours and for bacterial examination every eight hours. Composite chemical samples were then prepared for daily, weekly and monthly tests.

Test Wells for Alaska Bridge Sunk Through Ice

Wash-Drill Boring Rig Is Hauled 160 Miles by Railway, Sleds and Dog-Teams—Outfit Housed in Tent

SINKING test wells for the location of a bridge site in Alaska furnished some hard winter work for the Alaska Engineering Commission. The site is at the proposed crossing of the Susitna River by the Government railway, and is about 147 miles north of Anchorage. The main line is laid out to cross the Susitna River diagonally, striking the north bank just above the mouth of the Indian River. The railway runs nearly due north and the angle of crossing is about 30°.

Wash-Drill Rig and Work

The work was carried out during January to March, 1917. The drill tests for foundations were of a preliminary nature, and were made with a wash drill operated by hand power. To provide against freezing, the entire output was housed in a tent on a 14x20 ft. platform on skids, and a wood-burning heater and hot-water tank were installed within. The drilling was done from this platform on top of the ice. Only on the coldest days was it found necessary to thaw out the pump and water pipes. One of the accompanying views shows this tent being moved across the open channel of the river on a temporary bridge of cottonwood saplings.

The equipment for this drill work, including all supplies, amounted to about four tons. Half of this was moved from Anchorage to the bridge site, a distance of 159 miles by trail and constructed road. The rest was moved 16 miles from Dead Horse Hill storehouse to the bridge site. Transportation was made from Anchorage to Matanuska by the railway of the Alaskan Engineering Commission, 36 miles; from Matanuska to Dead Horse Hill by bob sleds and double-enders, 107 miles; and from Dead Horse Hill to bridge site by dog teams, 16 miles. Heavy snow prevailed throughout the first part of the trip, making traveling very slow, and about three weeks were consumed in transporting equipment and supplies. A party of 11 men was taken and was away from Anchorage for 2½ months.

Results of the Drilling

From the nature of the surrounding country it had been thought that hard formation would be encountered, not more than 15 ft. below the bed of the river. On this assumption the proposed design was for three 200-ft. steel-truss spans on concrete piers and abutments, with a 210-ft. trestle approach at the north end. The south approach would be in a cut. Test pits at the south abutment and drill tests at the north abutment and both channel piers showed no hard formation within reasonable depths.

The deepest test hole was sunk 53 ft. below bed of river. It showed from top to bottom 12 ft. of gravel and boulders, 29 ft. of fine sand and clay, 8 ft. of hard packed sand and gravel and 4 ft. of sand. The hole ended on a boulder.

The ice in this river jams badly when it breaks up in the spring. Ice jams have been known to raise ordinary

DRILLING TEST HOLES FOR RAILWAY BRIDGE FOUNDATIONS IN ALASKA
A—Transporting rig and material on double-ender sled. B—Transporting on dog-team sled. C—Men carrying A-frame of drill to bridge site. D—Drill house being moved across open channel of river

high water over 10 ft. at the bridge site. This would be about 11 ft. below base of rail on the proposed bridge, which is nearly 20 ft. above high-water level. To reduce the possibility of choking the river by two channel piers, it is now proposed to have two 300-ft. steel truss spans on concrete abutments over the channel of the river, and a 210-ft. framed trestle approach at the north end to give plenty of opening for flood water. The increased cost of steelwork is more than balanced by avoiding the construction of one large channel pier.

The work described above was done under the authority of W. J. H. Fogelstrom, Bridge Engineer for the Alaskan Engineering Commission. F. H. Chapin was in charge of the drilling party. As this crossing proved so difficult, and as it is practically impossible to procure steel for the truss spans, the Commission has sent out another location party to find an easier crossing. This party is in charge of Fred Browne. It is thought that if such a crossing can be found, it will probably be of advantage to adopt it.

Paid Foremen Superintend Road Tax-Workers In Alabama

One of the greatest sources of waste in local road work is due to the practice of allowing male taxpayers to work out their road taxes in many states. They do this when it best suits them, not when the roads need their attention the most. The work is often performed without proper supervision and a competent supervisor is often without any authority to compel good work. The state highway engineer of Alabama, W. S. Keller, reports that results good in comparison with the usual results from working out road taxes have been obtained in several counties in his state by placing the work in the hands of a few steadily employed foremen, who give all their time to it. These foremen are furnished with two or three teams with regular drivers, wagons, scrapers, grading machines, split-log drags, and the necessary small tools, and as many miles of road are assigned to each as he can work. A census is taken in each foreman's territory early in the year of all men subject to road duty. He is furnished with a list of names and is required to work every man who has not paid the required tax into the county treasury in lieu of his services. No foreman is allowed, under penalty of dismissal, to receive cash from work hands.

Edmonton Utilities Make Good Showing

For the first half of 1917 the public utilities of Edmonton, Alberta, earned $365,537 over operation and maintenance expenses, or $2000 a day. The surplus was distributed as follows: Electric light and power, $143,152; telephone, $92,165; water-works, $87,732; street railway, $42,488. Interest and depreciation charges are not reported. A. G. Harrison is city commissioner.

Worcester Owns and Operates a Model Garbage-Disposal Piggery

City Collects Garbage and Hauls It Many Miles to Poor Farm Where It Is Fed to Hogs—Under Modern Sanitary Conditions—Fish Offal Is Buried—Many Cost Data Are Given

By FREDERIC BONNET, JR.
Professor of Chemistry and Sanitation, Worcester Polytechnic Institute, Worcester, Mass.

AT THIS TIME, when every effort is being made to conserve our food resources, much interest is being shown in the economical disposal of garbage. So many requests have recently been made for information regarding the operation of Worcester's municipal pig farm that it was thought best to prepare and publish the following data from which it may be seen how one city, after many years of experience, is now turning garbage into a valuable food product and at the same time just about paying the cost of garbage collection.

Worcester is one of the old and well established cities of New England with a population of about 175,000. It is an industrial city with many diversified industries but with no unusual characteristics. Its foreign population, according to the census 1910, is only 33.5%.

In 1872 (population 44,000) the superintendent of the municipal poor farm began sending a wagon into the city now and then to collect enough garbage to feed the pigs. The work developed with the growth of the city until today about 70% of the garbage of Worcester (20 to 30 tons per day) is taken to the Home Farm and fed to 2000 to 3000 pigs. The garbage disposal has developed and continued along this one line for a longer time than has usually been the case in American municipalities. There has been a striking absence of unwise and unsuccessful experiment.

The Home Farm proper consists of 376 acres owned by the city. In addition, the city leases a farm of 220 acres, at a rental of $1500 a year. The farm is located in the northeastern part of the city. To get to it, the garbage teams coming from the center of the city have to pass over a ridge about 140 ft. high.

The city is divided into 21 districts from which the garbage is collected twice a week without charge to the householders or business men. There is also a special collection for the fish offal and rotten eggs from markets and commission houses, which collection is made daily in special cans with tight-fitting covers. These cans are provided by the dealers. Since this material is not fed to swine but is buried, as described later, no revenue is derived from it and it is a direct tax on the scavenger department of $1760 per year.

Hitherto, most of the hotel, restaurant and hospital garbage was privately collected, but owing to the recent falling off of the quantity and quality of the garbage, more of this is gradually being collected by the city. Some private collectors also obtain the privilege of collecting in certain outlying districts. All such collectors must first obtain a license from the Board of Health (Chapter 75, Revised Laws, Rule 22), and this is only given by the board after consultation with the superintendent of the Home Farm, who includes in his duties the supervision of the scavenger department, the sole purpose of which department is the collection and disposal of the garbage collected by the city. The arrangement with private collectors has not been wholly satisfactory.

For the city collectors, one load is considered a day's work. Each collector unloads his wagon and washes it. He also beds down his horses and curries them.

The feeding is not done by the collectors but by a farm employee especially assigned to this task.

The teams leave the Home Farm at 7 a.m. and have on an average a 13-mile haul daily (maximum 18 and minimum 10). It requires from 2 to 4 hours to make a load. Owing to the fact that Worcester has practically no alleys the average time per house collection is 1.65 minutes (maximum, 3.9; minimum, 0.4).

Separate Collection of Garbage

The rules of the Board of Health require "the individual householder to provide a suitable water-tight covered receptacle to keep garbage and swill until the same is removed by the city scavengers. This receptacle shall be kept covered at all times—it shall be kept on the ground floor and be convenient of access. No person shall deposit in the garbage—any tin cans, water (dish water not excepted), ashes, glass, sweepings, oyster or clam shells, sawdust, cork-dust, old boots or shoes, dead animals, etc."

These rules have been quite well understood and Worcester's garbage has in consequence been quite clean.

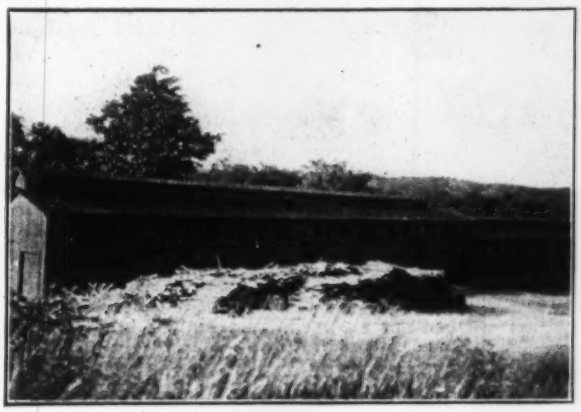
The garbage collected by the scavenger department has all been weighed at the Home Farm since May, 1914. The figures, which show a falling off in the amount produced, are given in Table I. A garbage inspector was appointed on May 1, 1917, whose duty it is to look after all collection complaints and to see

THE OLD PIGGERY AND MANURE PILES HAVE GONE

that collections, especially by private licensed collectors, are properly made. Owing to the high price of pork much garbage was stolen before the inspector was appointed, the amount of garbage dropping at one time from about 20 tons per day to 12.

Feeding to Hogs Economical and Sanitary

The garbage as collected is hauled to the Home Farm, weighed, and fed to a herd of 2000 to 3000 swine. As this system developed from small beginnings, the old farming methods were followed to within quite recent times. With the growth of the city these methods gave rise to considerable complaint because of odor. As a result a commission was appointed in 1914 to investigate and report. The commission consisted of the writer as chairman, the superintendent of the Home Farm and a member of the overseers of the poor under whose jurisdiction the Home Farm and Scavenger Department lie. This commission, after investigating all methods of disposal, concluded: "That disposal by feeding is the most economical method; that the greatest intrinsic value of the garbage, the feeding value, is made use of; that the garbage of Worcester can



THE NEW PIGGERY WAS BUILT IN 1913 AT A COST OF $3000 AND HAS A CENTRAL DRIVEWAY

not only be disposed of without cost but that the revenue from the sale of hogs has almost been sufficient to pay for collection."

The commission also made recommendations as to the conduct of the piggeries, feeding methods and the disposal of the manure, cleanings from the pens, the fish offal, prevention of flies and the breeding of rats. The commission was also interested to find whether there was any justification for the statement quite often made that hogs fed on municipal garbage are unfit for human food. They could find no justification whatever for such a statement.

Opinions of Sanitary Experts

Dr. Charles V. Chapin, the well-known health officer of Providence, R. I., stated in one of his annual reports that: "Feeding garbage to swine will not cause disease either in Providence or in the towns to which it is removed. In an experience of 19 years, I have never found a case of sickness that could thus be explained." Robert Spurr Weston, of Boston, has had to deal with the garbage disposal of a large sanitorium for tuberculosis patients. He states: "After considering the use of a small crematory or the burying of the garbage it was decided that it was wasteful to throw away so much good table refuse of high feeding value when animals could dispose of it at a profit. Careful post mortem examinations of the swine have failed to disclose any lesions due to infection and the experiment coincides with that of other corporations."

Dr. Edward Cahill of the Massachusetts Bureau of Animal Industry states that 95% of all the hogs of Massachusetts are garbage fed. Many more references might be cited to show that in the opinion of the highest sanitary experts garbage-fed hogs are in no way a menace to the public health. The fact that garbage-fed hogs bring the same price as other hogs shows that there is no discrimination against them by packers. It is quite conclusively shown, also, by the

TABLE I. TONS OF GARBAGE COLLECTED PER MONTH AT WORCESTER, MASS., 1914 TO 1916 *

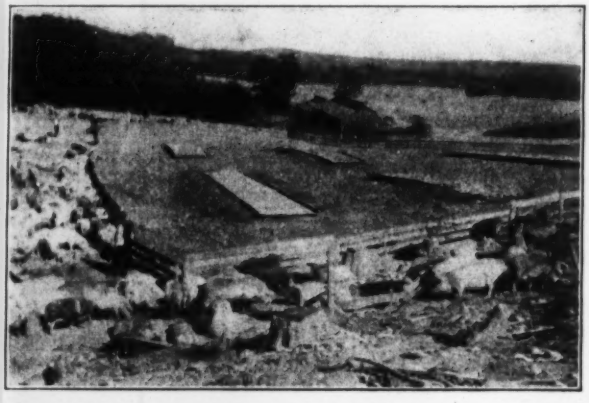
Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Av. T... per D...
1914					634.6	656.4	686.8	834.3	938.7	769.8	674.6	711.2	29.65
1915	700.8	538.8	625.2	589.2	596.8	582.4	675.2	686.7	856.3	676.3	568.1	563.6	26.42
1916	557.8	493.6	524.5	548.2	630.9	616.1	630.7	683.2	738.7	675.5	554.9	567.5	23.02

* No record kept before May, 1914.

figures for hogs sold from the Worcester pig farm. Of 2276 hogs sold to a packing house only 11 were condemned by the United States Government meat inspectors, an average of only 0.48%, which is much lower than on hogs shipped in from the West to the same packing company.

Operation of Garbage Piggery

The following description of the operation applies to Worcester's garbage-disposal plant as now operated under the able direction of Thomas Horne, superintendent, who has aided the writer in the preparation of this paper. The garbage as it comes to the farm is neither washed nor steamed. Washing is uneconomical because so much valuable food material is washed away and wasted; it is unnecessary since no material advantage is gained thereby. Cooking or steaming the garbage has been found by experience to be bad since the garbage is thereby made more acid than it ordinarily is and substances are incorporated in the food which are harmful to the hog and which would not



THE OUT-DOOR HOGS ARE WAITING TO GET TO THE WOODEN FEEDING PLATFORMS

be eaten in the raw garbage. A hog is more capable of picking over and culling garbage than any man or machine can be.

Pigs are kept with the sow in individual pens until they are six weeks old, although the pigs begin to eat garbage when about three weeks old. Boars are castrated when about five weeks old and are then left with the mother another week. The pigs remain in pens until they are about 6 months old and are fed from troughs. They then weigh about 75 to 100 lb.

Inoculation Against Cholera

The entire stock is treated by the so-called double-treatment method (virus and serum). Pigs 5 to 6 weeks old are inoculated with serum only. This treatment carries them for about 7 weeks when, at a weight of about 40 to 50 lb., they are given the double treatment, virus and serum. State veterinarians under the State Bureau of Animal Industry do this work free of charge, the department merely paying for the serum and virus used and for the necessary help. The cost of treatment depends upon the size of the animal since more serum is used the larger it is.

The serum costs 1¾c. per c.c. and about 20 c.c. are used for a 40 to 50-lb. hog, live weight, so that the

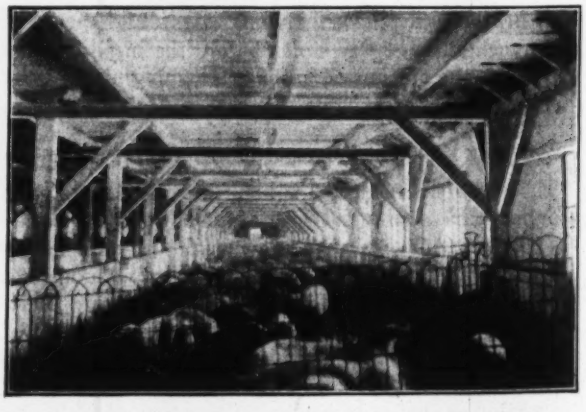
THE GARBAGE IS COLLECTED IN 2½-YARD TIGHT WOODEN WAGONS COSTING ABOUT $250 EACH

The garbage is first thrown into the front end of the wagon. A heavy canvas cover is gradually unrolled and tied down as the wagon fills

total cost of treatment exclusive of help is therefore about 70c. per pig. The place for injection (between the hind legs) is scrubbed with soap and water containing lysol or similar disinfectant and swabbed with tincture of iodine after puncture. Not one hog in 500 is lost and there is no trouble from ulcer formation if the inoculation is properly done. One veterinary with five helpers can treat 250 pigs of 40- to 50-lb. weight in a day.

To prevent itch the hogs are all sprayed about once in six weeks with a mixture of 3 parts of kerosene and 1 part of turpentine.

In February, 1915, the herd of swine at the Home Farm were visited by the dreaded hoof-and-mouth disease which was probably carried by crows from an infected herd of cattle nearby to the hogs fed out of doors. Federal and state authorities took charge of



PIGGERY NO. 6 SHOWS TYPE OF CONSTRUCTION

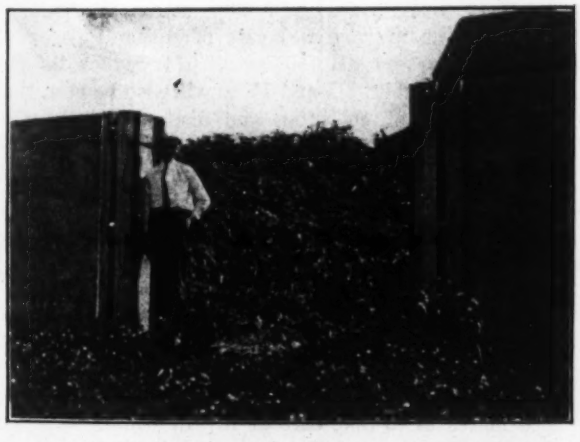
Note the wire partitions between the pens

the quarantine and the killing of some 2360 animals. The Federal Government paid one-half the assessed value of the infected animals and the state the other half. After killing, these animals were buried in pits with lime. Those not infected were killed for pork. The farm was not restocked until the following September. It is interesting to note that the disease did not infect the Home Farm herd of cattle. During this interval the garbage was dumped in a hollow on the farm and covered with loam. In June swarms of flies developed from this dump but by the use of traps, a kerosene-turpentine spray (3 to 1) and creosote spray, they were destroyed and kept under control.

After the hoof-and-mouth disease great pains were taken to rid the premises of rats. Poison, traps, shooting and "building out" were all employed. Many of the older buildings were condemned by the commission because they harbored so many rats. These rodents not only steal garbage but may prove a menace to the herd should they become infected. The only remedy for controlling them is by persistently killing them in every way possible and building them out. Crows are also a menace to the herd, as Worcester has discovered to her sorrow, and their presence on pig farms should be discouraged.

Out-of-Door Feeding Platforms

After six months the pigs which have grown to shoats are turned out into hog lots (100 pigs to about 3 acres) with out-of-door feeding platforms made in 8 x 8-ft. sections of 2-in. plank. These are mounted on skids and have a half round timber on two sides to prevent the garbage being pushed off. The cost per section was $7, with farm labor. Several sections are placed end to end and when the ground around the platforms becomes fouled the sections are skidded to another location and the ground at the former location plowed up. By this means the garbage trampled into the ground is kept from decaying and producing foul odors. The platforms are shovel cleaned daily and the material removed is composted or buried. The hogs are kept for about 15 months, when they are sold. They then weigh 250 to 300 lb. The last lot sold (May, 1917) brought 16.35c. per lb. on the hoof or 21c. per lb. dressed.



CONCRETE PITS ARE USED FOR COMPOSTING

The material is thrown in from the back and top. The boards which close the opening have been removed for hauling the compost away for use as fertilizer.

THE LARGER HOGS ARE PLACED ON A V-SHAPED TABLE FOR INOCULATION AGAINST CHOLERA

The sows are bred by turning about 300 of them into the same lot with about 30 boars for about five weeks. This makes it possible to control the farrowing so that there may be a sufficient number of pens. The first lot of brood sows are put with the boars from about Oct. 20, until Dec. 1. This brings the farrowing at the end of January, February and early March. After a month or six weeks a second lot of sows are bred and so on. During farrowing and sometimes during inoculation a little grain and middlings are fed. Boars are rarely kept more than two years and only prolific sows that are good mothers are kept for repeated breeding.

Old and New Pig Houses and Other Buildings

Up to 1914, there were 12 pig houses scattered about the farm. Seven of these were old piggeries or shelter sheds for outside hogs and have been torn down or are being used for other purposes. At present there are four pig houses in use, the dimensions of which are given in Table II, and two shelter houses. To provide additional pens for late spring farrowing 100 small portable take-down colony houses have been built at a cost of $20 each. These have proven excellent.

TABLE II. PRINCIPAL DIMENSIONS OF GARBAGE PIGGERIES AT WORCESTER HOME FARM

	Inside				Pens								
Piggery No.	Length, Ft.	Width, Ft.	Walk Width, Ft.		No.	Width, Ft.	Length, Ft.	Height to Ceiling, Ft.	No. 3x3-Ft. Windows	No. 4x6-Ft. Doors	Partitions Between Pens	Garbage Floor to Center, In.	Drain
1 rt. wing	180	19	6	side	30	6	12	8	30	3	wood	12	x12
1 lt. wing	190	25	5	ctr.	76	5	10	8	38	2	wood and wire	12	x12
5	241	30	5	ctr.	80	6	12½	..	40	2	wire	12	x12
6	241	30	5	ctr.	80	6	12½	..	40	2	wire	12	x12
11 rt. wing	100	20	5½	side	15	6	13½	..	24	7	wire	12	x12
11 lt. wing	106	20	5½	side	16	6	13½	..	24	7	wire	12	x13

The floors of all the piggeries are of concrete. At one end of each pen there is a slightly raised wooden platform for bedding to keep the pigs dry and warm.

Piggery No. 1 is the only one which is steam heated and is used for early farrowing. It is a well-built house erected about 25 years ago at an approximate cost of about $4,000.

Piggeries Nos. 5 and 6 are identical in construction and were built about 15 years ago at a cost of about $3,000 each.

Piggery No. 11 is the newest, having been built in 1913 at a cost of $3,000.

The pens are cleaned out daily. The cleanings, which consist of pig manure, urine, uneaten garbage and soiled bedding are carted away to the compost heap, which is inclosed by concrete walls. The cleanings, when not properly handled, may give trouble from odor. The commission already mentioned experimented with this material and found that when composted in layers with an equal volume of dry top soil, the rotten manure odor was wholly destroyed and only a slight musty odor remained after 10 days. The cleanings are quite wet and unless spread alternately in fairly thin layers with dry soil it takes a much longer time to mineralize the odor-giving substances. Objectionable odors may be carried a considerable distance when uncomposted material is spread on the ground as fertilizer, while the composted material is unobjectionable.

Since the bad odors are probably highly nitrogenous, composting by retaining these substances and mineralizing them would tend to increase the fertilizing value of the manure. About five cords of cleanings are produced daily (1500 to 1600 cords per year) and have a value of about $4 a cord as fertilizer at the farm. The Home Farm has never bought fertilizer in any material quantity for its farm land or truck garden and the scavenger department has never been credited with the value of the pig manure from the piggeries. There are two caretakers in each piggery except No. 11, which has one. One caretaker can care for about 250 to 300 pigs a day—feed them, bed them and clean out the pens.

Out-Door Hogs Improve the Farm

The out-door hogs are utilized in cleaning off the scrub from waste land and improving it. They chew and rip off the bark of practically all deciduous trees and thus kill them but coniferous trees are not touched. After chewing and stripping the bark they burrow around the roots, chew this bark and uproot the smaller stumps. In a remarkably short time (about two seasons) the scrub disappears and only the larger stumps must be pulled out before plowing is possible. Most of the cleared land of the Home Farm has thus been cleared and made into a very productive farm. Hog growers claim and it has been the experience at Worcester that such scrub acts somewhat as a tonic for the hogs and keeps them in good condition.

TABLE III. YEARLY COST OF GARBAGE COLLECTION AT WORCESTER, INCLUDING CAPITAL CHARGES

1 Foreman, $45 per month		$540
1 Fish offal collector, $42 per month		504
1 Inspector, $2.50 per day (not found)		780
21 Collectors, $37 per month		9,324
6 Helpers, $35 per month		2,520
29 Men's board and lodging, 52 weeks, $5.60		8,445
44 Horses' board, $27 per month		14,256
		$36,368
Interest on Investment:		
2 Horses and wagons, $800 each	$40	
Depreciation on teams, 13%	80	
Horseshoeing	50	
Wagon repairs	76	
Veterinary, hardware, etc	32	
Total for 1 team	$278	
For 22 teams		$6,116
Total cost		$42,285

TABLE IV. COST OF GARBAGE DISPOSAL PER YEAR AT WORCESTER, INCLUDING CAPITAL CHARGES

7 pig caretakers, 2 manure men, 1 compost man @ $37 per month	$4,440
Additional occasional help	1,320
Grain and bedding	2,640
Medicine (cerum, virus, disinfectants)	3,040
*Time of superintendent, farm foreman, office	2,560
*Miscellaneous—light, heat, water	1,000
Interest on investment, 5%, buildings, $13,000	650
†Stock 200 hogs, @ $20, $40,000	2,000
Total	$17,650

* Estimated. † Estimated that 2,000 hogs are a necessary minimum for 20 tons daily capacity.

In September, 1915, when the farm was restocked after the hoof-and-mouth disease, 1,200 shoats of an average weight under 20 lb., 100 sows and 5 boars were purchased for $7,700. All the garbage collected was not consumed by this herd and additional stock was purchased, which brought up the total stock purchased to about $10,000.

From September, 1915, to January, 1917, $16,000 worth of pork was sold, and from Jan. 1 to June, 1917, $21,000 worth of pork was sold. There is on hand at the present time stock valued at $50,200.

TABLE V. YEARLY QUANTITIES OF GARBAGE COLLECTED, NUMBER OF PIGS AND FINANCIAL RESULTS AT WORCESTER, 1898 TO 1916

Year	Garbage Collected per Day Loads	Cubic Yards	Tons	No. of Pigs on Nov. 30	Financial Summaries for Each Year Ea. Yr. Total Expenditures	Total Receipts	Net Cost	Net Profit
1898					$14,804 34	$7,674 02	$7,130 32	
1899					17,109 00	10,641 52	6,467 48	
1900	19	52 8			17,715 21	11,947 91	5,767 30	
1901	19	52 8			18,935 86	13,933 03	5,002 83	
1902	19	52 8			18,765 03	18,766 99		$1 96
1903	19	52 8			18,140 57	11,941 55	6,199 02	
1904	21	57 5			22,326 02	7,327 00	14,999 02	
1905	21	57 5			20,515 83	12,539 20	7,976 63	
1906	21	57.5	31 5		23,525 49	19,321 00	4,204 49	
1907				2,850	30,491 93	24,830 71	5,661 22	
1908					34,475 73	24,321 22	10,154 51	
1909					37,737 79	29,257 25	8,480 54	
1910					37,039 68	43,224 25		4,184 57
1911				1,388	41,121 74	25,579 58	15,542 16	
1912				2,057	45,750 28	22,863 27	22,887 01	
1913				2,167	53,109 10	38,376 11	14,732 99	
1914			28 4	2,502	53,325 62	38,838 67	14,486 95	
1915	21	52 5	22 2	1,300	55,718 43	39,994 36	15,724 07	
*1916	21		23 03		57,680 03	16,692 99	40,987 04	

* Note.—Hoof-and-mouth disease. For 5 months in 1915 the garbage was buried. Farm restocked late in 1915 and early in 1916.

TABLE VI. ESTIMATED COST OF GARBAGE PIGGERY WITH CAPACITY OF 20 TO 30 TONS A DAY

Based on Conditions Existing at Worcester, Mass. Land Not Included.

Four buildings with a pen capacity of about 300 pens, 6x12 ft., including small heating plant for one house, water-supply, drainage, platforms and fencing		$30,000
3 horses, wagons and sleds for disposal work		1,500
Stock on hand June, 1917:		
1,100 swine @ $30	$33,000	
100 sows @ $25	2,500	
800 shoats (50–100 lb.) @ $12	9,600	
900 pigs @ $5	4,500	
30 boars @ $20	600	50,200
Total		$81,700

Tables III and IV give the cost of collection and disposal for one year. Table V shows the operating cost and income of the scavenger department over a number of years. Including the years 1902 and 1910, which showed a clear profit over and above the cost of collection, the average net cost of disposal per year for 19 years was $10,169, or $0.074 per capita per year. From Tables III and IV it will also be seen that the total cost of collection and disposal per year is $60,435. About 1500 swine are sold each year and with the present price of pork will bring about $40 each or a total of $60,000. This will just about pay for the cost of collection and disposal. Table VI gives the estimated first cost of building and stocking a 20 to 30-ton garbage piggery.

The feeding method is very plastic and no part of the plant is idle or running below capacity part of the year. When the quantity of garbage becomes less hogs are sold off, and as the quantity increases, the herd increases to take care of it. In winter there are about 2000 swine on the farm and in summer 3500. About 100 to 150 pigs, depending upon size, will consume one ton of garbage per day.

Experience has shown that feeding garbage to hogs is the most economical and satisfactory method of disposal at Worcester and that it can be done in a sanitary manner without appreciable odor if given intelligent care.

Small Circular Concrete Bins Used for Storage of Cement

Universal Mill at Duluth Has New Pockets Designed for Hydrostatic Pressure of 25 Pounds per Square Foot.

REINFORCED-CONCRETE bins for the storage of cement, similar in design to the more common grain-elevator bin, have just been completed for the Duluth mill of the Universal Portland Cement Co. This type was adopted after studies showed that small bins had greater flexibility of operation and that the circular design was more economical than the rectangular.

The structure as built consists of 27 circular bins, each 33 ft. in diameter by 50 ft. high, with two packing rooms having car sheds, or canopies, a loading platform on each side, a superstructure for the conveying machinery to the bins, and tunnels underneath for conveying cement from bins to packing rooms.

The bins are grouped in three rows and are separated into two batteries by one of the packing rooms, one battery of 18 and one of 9 bins. Fourteen interspaces formed by the meeting of outer wall surfaces are also utilized for storage. The 27 circular bins have a capacity of 10,300 bbl. each, while the 14 interspace bins have a capacity of 2200 bbl. each, thus making a total storage capacity slightly in excess of the desired 300,000 barrels.

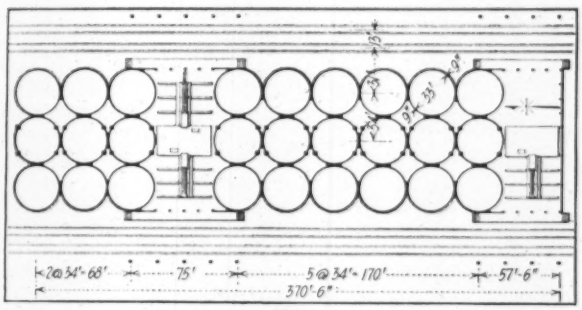


FIG. 1

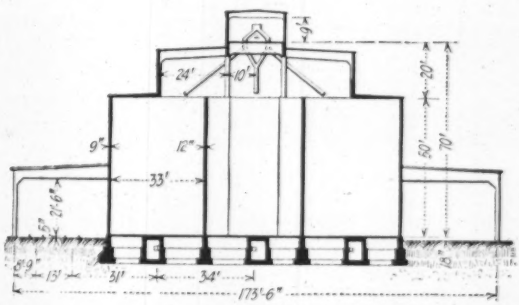


FIG. 2

DETAILS OF LAYOUT OF UNIVERSAL PORTLAND CEMENT CONCRETE CEMENT-STORAGE BINS

The bin walls have a uniform thickness of 9 in. except where they intersect, at which point they are 12 in. thick. Angles at the intersection are filled in to a distance of 5 ft. on each side of the center line. The horizontal reinforcement consists of ¾-in. rods for the first 25 ft. from the foundations, ⅝-in. rods for the next 10 ft. and ½-in. rods for the remaining 15 ft. Three rods are used to complete the circle, rods being lapped 4 ft. at each splice. All laps are staggered. The ¾-in. rods are spaced 4 in. apart for the first 10 ft. of the bin walls, 5 in. apart for the next 10 ft. and 6 in. for the next 5 ft.; the ⅝-in. rods are spaced 5 in. apart for the first 5 ft. and 6 in. for the next 5 ft.; the ½-in. rods are spaced 5 in. apart for the first 5 ft. and 8 in. for the remaining 10 ft. The vertical reinforcement consists of ½-in. rods spaced 2 ft. 6 in. apart—standard practice being followed closely.

NEW CEMENT STORAGE BINS BUILT OF REINFORCED CONCRETE

As shown in the drawing, the bins are founded on footing courses, which was more economical than a slab foundation, but not as satisfactory in stability. In future work, unless the ground is of very solid formation, it is probable that a continuous slab footing will be used.

Experiments Determine Design Pressures

As a result of experiments, the company concluded that, although cement maintains a more or less stable angle of repose, conditions arise to prevent a uniform flowing action during discharge or withdrawal from the bottom of the bin, and the cement is likely to remain or hang in a vertical position, or possibly even "undercut." It was further concluded from these experiments that a wall designed to withstand a hydrostatic pressure of 20 lb. per sq.ft. is ample to take care of any likely variations of pressure that will occur in bins of the usual dimensions and, say, of 40,000-bbl. capacity. The design of an earlier stockhouse was based on a hydrostatic pressure of 20 lb. per sq.ft. and no visible sign of overstraining has developed in this structure during the time it has been in operation. However, with circular bins of less diameter and greater height, a design based on a pressure of 25 lb. was deemed advisable, due to the changed conditions.

Operating Equipment Detailed

Tunnels, one of which is beneath the center of each row of bins, are built in conjunction with the foundations. They contain the screw conveyors that move the cement from the bins to the elevators leading to the packing-machine hoppers in the packing rooms. The roofs of the tunnels form a part of the bin floor and have five openings to each bin, through which the cement flows to the screw conveyors. As the tunnel roofs are subjected to the pressure of the overhead cement, they are reinforced with ¾-in. bars spaced 4 in. c. to c. To resist the upward thrust of the ground, the bottom, or floor, of the tunnels is also reinforced.

Spaces between the tunnels and bin foundations are filled in with earth, on which the bin floors are placed, allowance being made for subsequent settlement from the weight of the cement. Surmounting the bins is a double-decked reinforced-concrete superstructure that houses the belt-conveying apparatus and the spouts that distribute the cement to the various bins as it comes from the finishing mill. This design provides a narrow upper deck, or monitor, for the conveyor belt and a broader lower section to give sufficient incline for the spouts to the two outer rows of bins. To relieve the bin walls of some of the dead-load, pilasters were built in conjunction with the walls of the middle row of bins from the foundation to the superstructure.

Over the packing room, the superstructure is carried on reinforced-concrete girders spanning 48 ft. from center to center. As the length of the structure is 388 ft. and the extremes in temperature are considerable, provision for expansion was made at the central packing room by means of sliding joints where the girders rest on the supporting columns. The roof of this building consists of reinforced-concrete slabs, cast in place.

The packing rooms, which house the packing equipment, consisting of automatic packing machines and hoppers, are of the same general layout, except that the one between the bins may receive cement from either side and has two elevators, while the end packing room receives from one side only. Beneath each is a basement containing the driving machinery for the screw conveyors in the tunnels and the cross screw conveyors that carry the cement from any of the tunnel screw conveyors to a bucket elevator, by which it is delivered to the second floor of the packing room.

All conveying machinery in the tunnels, basements and packing rooms is driven by electric motors direct-connected to speed reducers that drive the conveyors at the proper speed. By this method the driving mechanism is simplified and the number of moving parts greatly reduced, thereby lessening the hazard of injury to the operators.

The end packing room has a slanting roof of structural steel covered with cement tile. Should the storage capacity of the plant be increased at a future date, the extension will be built from this packing room; and this type of roof admits of easy alteration.

The stockhouse was designed by the company's own enginering department, which also furnished the specifications and all detail drawings for its erection. It was erected by Haglin-Stahr Co., of Minneapolis.

Government Supplies Will Get Right-of-Way

During the next few months it is estimated that more than 100,000 cars will be needed for government purposes. Under the plans agreed upon by the Railroads' War Board and representatives of the Government, the Government will give advance notice to the War Board's Commission on Car Service whenever orders are placed for more than ten carloads of materials or supplies. The Government will also issue where necessary through its authorized representatives orders to the railroads on which the supplies are to be shipped instructing them to provide the number of cars ordered within the time specified and at the shipping points designated.

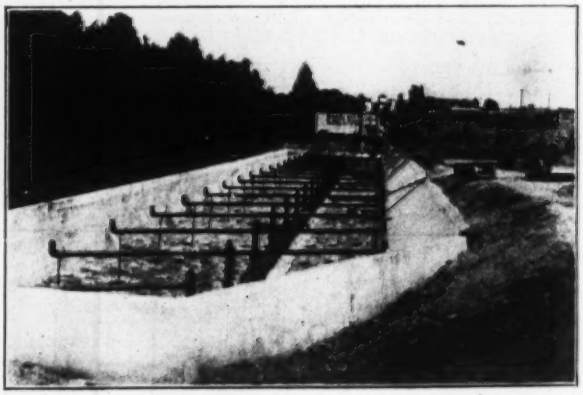
Remodeling a Small Sewage Works in California

Stream-Pollution Suit Leads To Replacing Makeshift Filter with Sprinkling Filter—Final Settling Tank Added

THE new sprinkling filter at Reedley, Calif, shown in in the accompanying views, replaces a makeshift filter constructed in 1914. An Imhoff tank has been retained in use, a dosing chamber remodeled and a final settling tank added.

The original filter was merely an excavation about 160 x 25 ft., and 18 in. deep, in a narrow strip of land between the county road and the Kings River, into which its effluent discharged. This location was selected because it was the only point to which there was gravity flow all the way. Hence the peculiar relation of length to width. The bottom of the filter had drains of 4-in. tile spaced about 20 ft., with a ventilating riser at the end of each row. The filter material was just a little coarser than 1-in. screenings. The distribution was by means of perforated 6-in. galvanized sheet-metal pipe.

An injunction was sought by Kings County to prevent discharge of sewage into Kings River. The City of Reedley finally had the injunction stayed by agreeing to enlist the aid of the State Board of Health in working out a satisfactory scheme. The board found the Kings River to be a beautiful stream whose banks were favorite camp sites for fruit-pickers, while the water is used for irrigation. Accordingly, the city was advised that complete exclusion of the sewage from the stream, or treatment to the point of stability, would be required. During the season of low flow, sterilization of the effluent would also be necessary unless the city found it possible to spread the sewage over sand-bars along the stream. After different plans had been considered, a modern sprinkling filter was recommended as the least expensive.



SPRINKLING FILTER READY FOR FILLING

In November, 1915, the California State Board of Health prepared the basic drawings, which were then turned over to the city's consulting engineer, Chris. P. Jensen. The filter was put into operation in October, 1916. It is 30 x 180 ft., and 5 ft. deep, with crushed stone of 1- to 2½-in. size.

The most interesting feature of the plant is the utilization of the old dosing tank. While this is several feet

SPRINKLING FILTER IN OPERATION

too high to provide for uniform distribution at low head, it was made usable by constructing a vertical stack 2 ft. wide and 4 ft. long, at the outlet of one of the siphons. This has its floor on a level with the nozzles and 4½ ft. below the bottom of the existing dosing chamber. The head builds up in this stack to about 4½ ft. above the nozzles. There are 51 circular-spray Taylor nozzles. A test for uniformity of distribution shows fairly satisfactory results, as indicated by the accompanying table.

DISTRIBUTION TESTS OF CIRCULAR TAYLOR NOZZLES

	—Per Cent. of Area Receiving Dose—			Amplification
Per Cent. of Average Dose	Test 1	Test 2	Test 3	of Test No. 3
20 to 50	36	0		
50 to 150	52	85	100	
150 to 200	12	15		
90 to 100				52
100 to 110				28
110 to 120				20

Excellent results have so far been obtained in clarification, stability and bacterial removal, the total suspended matter being reduced from 85 to 3 parts per million, putrescibility absent at least 20 days, and bacterial efficiency about 82%. The sewage now flows over the sand-bar and has no effect whatever upon the river. A one-story final settling tank, designed on the septic-tank principle, is provided to hold back the material released when unloading.

The population of Reedley is about 1700. The average daily sewage flow is 140,000 gal. The settling period in the Imhoff tank is 5.5 hours; frequency of dosing, 24 min.; time of dosing, 3 to 5 min. The rate of filtration is 1,140,000 gal. per day on 0.123 acre. Though the filter is adjacent to a country road having considerable traffic, no complaints have been made to the authorities. The installation is thought to be the most successful plant in California for complete sewage treatment.

Waterbound Macadam at Providence

The construction of waterbound macadam streets in Providence has been abandoned, except in cases of unusually light traffic, in accordance with a recommendation by Walter F. Slade, commissioner of public works. In the future, Mr. Slade states, bituminous macadam or other more durable pavement will be used, as the traffic conditions may demand. Mr. Slade informs us that: "In conformity with such recommendation, the city is now building more durable pavements as fast as the highway appropriation will permit."

Camp Management Helps To Solve California Labor Problems

Desirable Men Attracted by Good Food and Living Conditions More Than by Prospect of Easy Work

INDUSTRIAL opportunities in Eastern states have made heavy draft upon skilled labor available in the West, while the call to arms from countries at war has been drawing foreign labor from construction camps in all quarters. Thus on the Pacific Coast the shortage of common labor is increasing in importance, and construction superintendents are making special efforts to meet the situation.

The usual spirit of restlessness among the men is more manifest than ever, and a crew cannot be kept at work unless more attention is given to camp management than was formerly necessary. An important conclusion which is now being generally accepted is that if a camp affords plenty of good food and good living conditions, the men will remain rather than go to a camp where the work is easier, but general conditions are not so good.

THESE MARRIED QUARTERS RENT FOR THREE TO FIVE DOLLARS A MONTH, INCLUDING WATER AND LIGHT

The Difference That Good Camps Make

On a construction job in California, where about 1000 laborers are employed, there is an excellent opportunity to compare what good and bad camp conditions will do under the same labor requirement, because part of the work is being done by the owners on the day-labor basis with very carefully managed camps, while a number of the smaller contractors have extremely poor camp conditions.

On this work a considerable percentage of the men employed by the contractors stay on the job only four or five days, and the average service they get from a man is between one and two months. On the other hand, in the camps managed on the day-labor basis, where practically the same kind of work is done by laborers of the same nationality, the average length of service is six months. Moreover, a large percentage of the men

LARGE STRUCTURE CONTAINS MESS HALL AND CLUBROOMS—TYPICAL BUNKHOUSES AT LEFT

from the day-labor camps who "go out to spend their stake" at intervals return again to the same camps, so that many of them have been on the work with occasional absences for two or three years.

The difference in conditions is largely one of policy. In the contractors' camps tents are usually pitched on the ground, without floors or screens, and only such temporary camp work as is absolutely essential is done. The food is of an inferior quality and often not well prepared. On the other hand, in the owner's camps comfortable bunkhouses are built of rough lumber and equipped with screened doors and windows; or where tents are used, floors and wainscoting are provided, and screens are put in.

Moreover, in the day-labor camps careful attention is given to sanitary conditions, and men are employed only after passing a physical examination calculated to discover any contagious diseases or unfitness for the work. In the case of cooks and cookees, the requirements are more exacting, and the physical examination includes tests for heart or lung trouble and venereal diseases. It is notable that 30% of those applying for kitchen positions on this work were unable to pass.

All these measures involve a greater first cost, naturally, but are believed to be good investments. The owners can do work for an average of 75%, it is claimed, of what it costs the contractors, this difference being entirely a matter of efficiency of organization.

Keeping "Johnson" Happy

In studying the conditions under which the men work best, the peculiarities of the particular kind of labor employed have to be considered. A large percentage of laborers in California construction camps are Swedes. In one camp of about 65 there were 17 men named Johnson. The time-keeper avoided confusion in making out pay checks by assigning a new middle initial to all Johnsons with the same initials. For example, three Johnsons who signed John T. were made John X., John Y. and John Z. respectively. This was near enough the true name to satisfy the owner, and letters taken from the end of the alphabet at once indicated to the auditing department that the unusual initial was for purposes of identification.

Perhaps the most important element to be considered in keeping the men well satisfied is in getting them to take pride in their work. In order to do this, friendly rivalry between gangs working on the same kind of work is encouraged, and progress is either posted as an announcement or is reported to the foreman so that it may become generally known among the men. Where a bonus is offered, as in the case of tunnel driving, this is added to pay checks only if the man has been on the job for the specified 60 or 90 days.

On one of the jobs above referred to, taken as a typical camp, it was found that 90% of the laborers periodically go to town to spend their savings. The problem is to keep the men as well contented as possible while they remain on the job.

A hospital plan adopted on a large job recently undertaken in California is to deduct a hospital fee of 75c. per month from each man's pay and to contract with a doctor at $1 per month per man for all medical and surgical attention. It was decided to establish a single base hospital with two branch hospitals to take care of the 2500 men to be employed. This decision was made on the belief that it was better to take the injured to well-equipped points rather than to place greater emphasis on the attention at each of the many construction camps where at best only inferior equipment would be available.

By having the contracting doctor or his deputies make the physical examination of all men applying for positions, the responsibility for employing only the physically fit rested upon the man who would be the first to lose if they later proved to be otherwise. The difference between the 75c. per month paid by each man and the $1 per month which the doctor receives is made up by a reduction in the casualty insurance fees which are paid under the employers' liability act. This reduction was agreed to by the insurance company upon being relieved of the work which the doctor takes over

Points in Steel-Bridge Maintenance

Safety Assured by Watching Camber Curve—Stronger Lateral and Portal Systems Lengthen Life of Bridge—Experience on the Santa Fe

SO LONG as the deflection or camber curve of a steel bridge is regular, says A. F. Robinson, bridge engineer of the Atchison, Topeka & San Fé Ry., relatively high unit stresses in trusses are no ground for serious alarm. The deflections can be observed by sitting on a pier or abutment and watching the successive panel points while a train passes over; irregular or localized deflection can be located by eye.

It is important to notice whether two corresponding points on opposite sides of the span deflect equally. If they do, and if the entire curve of maximum deflection shows no sharp angles, it is pretty certain that no member or detail is taxed much more than any other. Whether the curve stays above the horizontal or is straight or droops is immaterial. The determining matter is whether or not it is smooth.

In many years' experience on the Santa Fé system few spans have been taken out on account of excessive stress in the body of a truss member. The immediate reason in every case of replacement was weakness of floor, laterals or truss details.

An instructive case in recent experience is that of the road's Des Moines River bridge, a structure of six 150-ft. deck spans located in a sag, where all trains cross at high speed. The spans were of pin-connected type and had lateral and sway systems made of rod diagonals. The bridge fairly danced under trains.

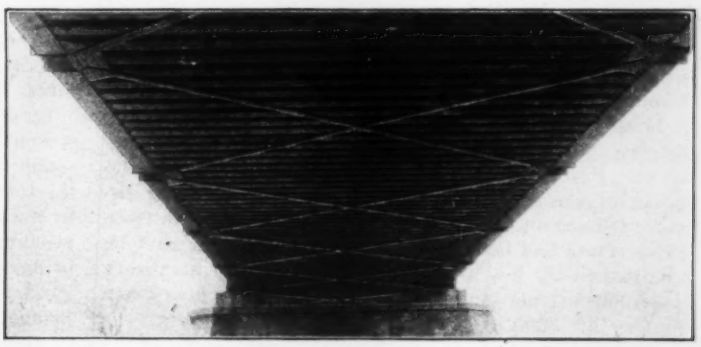
BRIDGES OF EARLY DESIGN WITH LIGHT PORTALS OFTEN LACK STIFFNESS

The calculated stresses in the main members did not exceed 16,000 to 17,000 lb. per sq.in. net, yet it was impossible to hold the laterals and counters tight for any great length of time, although they did not have bent end connections. Local conditions made the maintenance of falsework for any extended period impracticable. The spans were therefore taken out and new ones installed. The new bridge is also pin-connected, but it has ballasted floor and riveted laterals and sways. It is as steady as a full-riveted bridge.

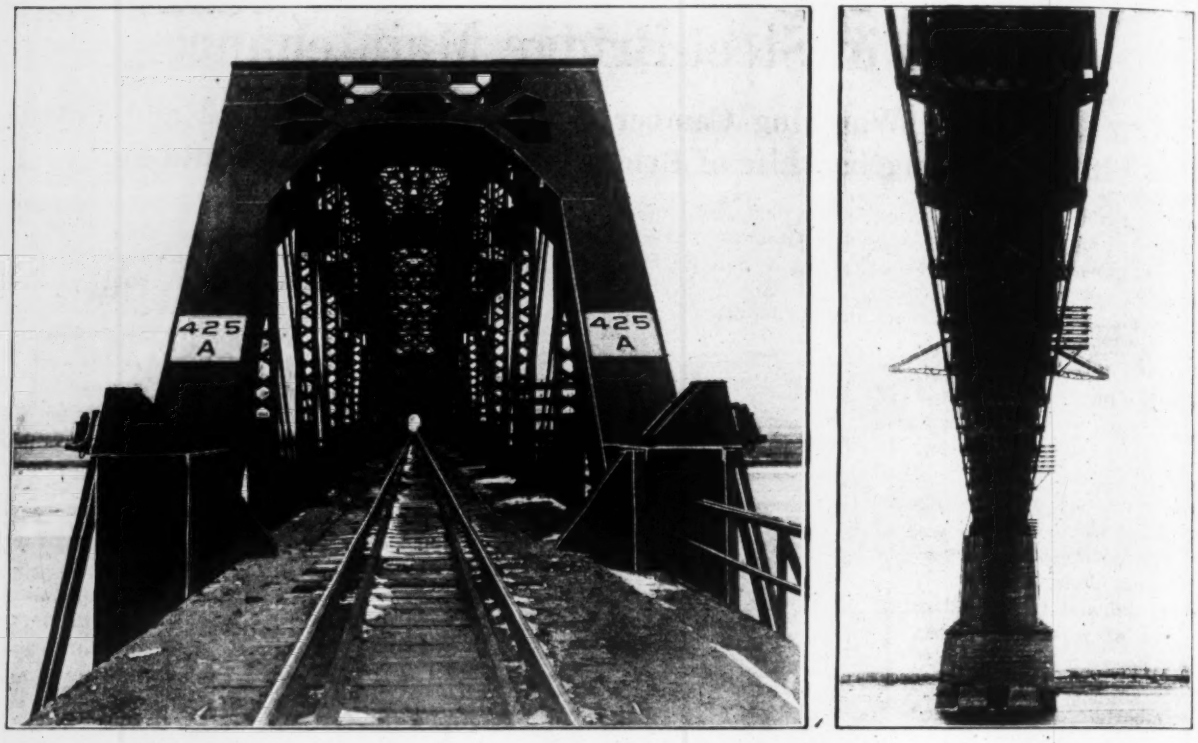
While the exact amount of deflection is not considered a deciding factor, but rather the regularity of the curve, there have been a few instances of replacement on account of excessive deflections. In one such case—a 164-ft. span in California, between Barstow and San Bernardino—the division operating officials complained of excessive deflection when heavy Mallets began to operate over it. It was said to be too "soft."

The stress calculations showed that, while some main members had stresses higher than allowable under the standard specification, yet the span ought to be satisfactory for several years more, or until specific trouble was found. There being eight or nine similar spans elsewhere on the line, it would be logical to replace all of them if a single one were condemned.

A maximum deflection of about 2 in. was reported; when this was questioned, more careful observations



HEAVY FLOOR CONSTRUCTION MAKES STIFF BRIDGES. SIDE STRINGERS 24-INCH I-BEAMS 20 INCHES APART. LATERALS OF ⅝-INCH AND ¾-INCH FLATS TO ABSORB ENGINE NOSING



HEAVY PORTAL AND LATERAL SYSTEMS GIVE HIGH ENDURANCE—SIBLEY BRIDGE OVER MISSOURI RIVER

were made by the local officials and the deflection reported as 1¾ in.—still extremely high for so short a span. When the bridge engineer went over the structure, he did not find a single loose rivet or a faulty detail. His personal inspection showed that the reported deflection occurred at midspan. The span seemed to squat right down under the train, but came up again fully, and the camber curve was smooth and regular.

On these facts it was decided that the span was safe. Nevertheless, in this particular case a new bridge was ordered, as the Operating Department's objections were thought to be a sufficient reason for immediate renewal.

Loose rivets have given very little trouble on the Santa Fé. They are apt to be found in the floor framing here as well as on other roads, however.

One exceptional case of rivet trouble in the floor is the flange riveting of an end floor-beam which carries a tie in a drawspan. Most of the flange rivets have been loosened by the pounding of trains coming on from the abutment. This kind of trouble is being forestalled in new designs by providing stringer extensions so as to maintain the regular tie spacing.

Loose rivets are found most frequently in the stringer hitches, but some also occur in the floor-beam connections. Practically all floor-beams are fastened to the posts by face connections. While these theoretically involve tension on the upper rivets, no special trouble from loose rivets has developed there. This may in part be credited to the low unit stresses used in floor steelwork —18,000 lb. per sq.in. on net section of floor-beam flanges and 4000 lb. per sq.in. shear on field rivets.

Another factor in the matter, however, is the heavy roadway that is used on the system. No bridge is designed for a roadway dead-load of less than 1400 lb. per lin.ft. per track. Further, during the past 15 years no open-floor bridge has been built on the main line. As is well known to railway-bridge men, the solid timber type of deck with ballast track support has had its most extensive use by far on the Santa Fé, and Mr. Robinson is considered the originator and principal backer of this type of floor.

Lattice bars of compression members have not proved to be points of weakness, during the past dozen years or so at least. In this period the practice of the system has been to use very heavy latticing. Many members that in ordinary detailing are likely to be latticed with 3 x ⅜-in. bars have 6 x ⅜-in. bars on the Santa Fé, and two-rivet or four-rivet connections.

Another experience of the last decade is that heavy portal construction is worth while. The light portals of prior times occasionally showed weakness; in conjunction with light lateral systems they produce excessive sway and vibration under traffic. The cause of this may be found probably in the old standard practice of proportioning laterals and portals to resist a given wind force, while the real attack is the effect of traffic.

By proportioning for a fixed wind pressure, the lateral strength is made to vary with span length; and short spans thus are apt to become too weak laterally, since the train effect does not necessarily vary in direct ratio to span. With these conditions in mind, the Santa Fé provides lateral and portal systems designed to hold the bridge steady under traffic rather than to resist a fixed wind force. The actual calculation for any particular bridge is based on an assumed wind load, but the amount of this load is varied to suit the case. It is never less than 1000 lb. per lin.ft. of bridge, and of this about 70% in all cases is applied at the floor level.

Serial Bonds for Road Building Save Money

Tables and Diagrams Show That Sinking-Fund and Annuity Methods Cost Taxpayers Many Millions

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DEFINITE comparisons between the ultimate costs of different types of bond show that the serial type is most desirable. Especially in local road-improvement work, where the sinking funds lead to many troubles, serial bonds are greatly to be preferred. The tables and charts given herewith make it possible for anyone to verify the conclusions.

Bond issues ought to be resorted to only where they cannot be avoided. It should be a fundamental rule in the financial operations of a county or township that all current expenses, such as for the maintenance of roads, be paid from the proceeds of an annual tax levy. Furthermore, if a township or county is able to levy a sufficient tax to improve all of the roads required in a reasonable length of time without imposing too great a burden on the taxpayers, it should by all means adopt this course.

The only defense that can be offered for a local bond issue rests upon the common-sense principles of payment by installment and of capitalizing undeveloped resources. If a system of roads is to be built, it is usually of common advantage that the people who may be called upon to pay the bills should be permitted to distribute their contributions over a period of years and that all who share in the benefits should also share in the burdens.

Engineering Considerations of Road-Building Economics

Before a community invests its money in a system of roads, it should consider the traffic area of the road or roads to be improved; the present and future traffic in ton-miles per annum, the estimated cost of hauling per ton-mile at present and what it probably will be reduced to by the improvement; the roads to be improved; the approximate cost of the improvement as borne out by surveys and estimates made by a competent highway engineer; the probable effects of the improvement on farm values, school consolidation and attendance, community betterment and the rural delivery of the mails; and whether the work can be carried on by direct taxation or whether it is desirable to resort to credit.

A comprehensive study of these facts will enable a community to determine whether it can afford to invest its money in good roads, how much it can invest profitably, how many miles of road it should build, what type of roads it would be most economical to construct, which roads should be improved first, and whether it would be wise to proceed under a cash basis or whether it would be best to issue bonds.

If the people decide that it would be wise to issue bonds and distribute the burden over a period of years, then they should determine with careful forethought what kind of bonds should be issued, whether long-term or short-term, whether sinking-fund, annuity or serial bonds, and what taxes should be imposed in order to extinguish the debt.

Financial Status of Community Should Be Carefully Weighed

In determining the question of term or life of a bond issue, consideration should be given not only to the character of the improvement to be financed, but also to the ability of the township or county to dispose of the debt as quickly as possible, without imposing too great a burden upon the taxpayers. The indebtedness should be liquidated at a rate at least equivalent to the depreciation of the improvements thus financed. The payments should be so distributed over a period of years as to avoid the two extremes of excessive or confiscatory levies on the one hand to pay off the debt too quickly, and the extension on the other hand of the debt beyond the life of the utility, in order to obtain a low annual tax rate. A revenue measure that makes sudden and rapid changes in the rates of taxation is the occasion of unnecessary inconvenience and vexation to the taxpayer.

Many road bonds are issued for terms of 30 years and over in order to obtain a low annual charge for interest and principal. An examination of the chart, Fig. 1, and Tables I, II and III will show that very little advantage is gained by fixing the term of a bond longer than 25 or 30 years. On the other hand, if bonds are paid off earlier than 20 or 25 years, the average annual

Total Costs of Three Kinds of Bond

TABLE IV. TOTAL COST OF SINKING-FUND BOND

Total cost of a $100,000 sinking-fund bond bearing 3, 4, 5 or 6% interest, with sinking fund drawing 3½%, and maturing at different periods from 5 to 50 years.

Term in Years	3%	4%	5%	6%
5	108,241	113,241	118,241	123,241
10	115,241	125,241	135,241	145,241
15	122,738	137,738	152,738	167,738
20	130,722	150,722	170,722	190,722
25	139,185	164,185	189,185	214,185
30	148,114	178,114	208,114	238,114
35	157,494	192,494	227,494	262,494
40	167,309	207,309	247,309	287,309
45	177,540	222,540	267,540	312,540
50	188,169	238,169	288,169	338,169

TABLE V. TOTAL COST OF ANNUITY BOND

Total cost of a $100,000 annuity bond bearing 3, 4, 5 or 6% interest, and maturing at different periods from 5 to 50 years.

Term in Years	3%	4%	5%	6%
5	109,177	112,316	115,487	118,698
10	117,236	123,291	129,505	135,868
15	125,650	134,912	144,513	154,444
20	134,431	147,163	160,485	174,369
25	143,570	160,030	177,381	195,567
30	153,058	173,490	195,154	217,947
35	162,888	187,521	213,751	241,409
40	173,050	202,094	233,113	265,846
45	183,833	217,181	253,178	291,152
50	194,327	232,751	273,883	317,221

TABLE VI. TOTAL COST OF SERIAL BOND

Total cost of a $100,000 serial bond bearing 3, 4, 5 or 6% interest and maturing at different periods from 5 to 50 years.

Term in Years	3%	4%	5%	6%
5	109,000	112,000	115,000	118,000
10	116,500	122,000	127,500	133,000
15	124,000	132,000	140,000	148,000
20	131,500	142,000	152,500	163,000
25	139,000	152,000	165,000	178,000
30	146,500	162,000	177,500	193,000
35	154,000	172,000	190,000	208,000
40	161,500	182,000	202,500	223,000
45	169,000	192,000	215,000	238,000
50	176,500	202,000	227,500	253,000

cost of interest and principal will be so high as to necessitate the levy of an annual tax which might in some cases be considered excessive.

Term and Character of Bonds Should Be Limited by Statute

In some of the states, during the past few years the term and character of bonds have been fixed by statute. In Maryland, for instance, state bonds for public roads must be paid off in 15 years, even though the roads con-

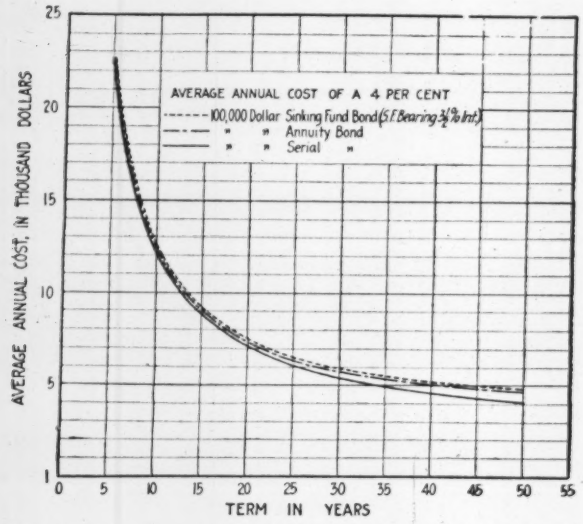

AVERAGE ANNUAL COST OF A 4 PER CENT
100,000 Dollar Sinking Fund Bond (S.F. Bearing 3½% Int.)
" " Annuity Bond
" " Serial "
AVERAGE ANNUAL COST, IN THOUSAND DOLLARS
TERM IN YEARS
0 5 10 15 20 25 30 35 40 45 50 55
1 5 10 15 20 25

FIG. 1. LITTLE ADVANTAGE IS GAINED THROUGH BONDS RUNNING MORE THAN 25 YEARS

structed from the proceeds are the most permanent and durable that it is possible to build. The method of bond amortization adopted by Maryland is referred to by the legislature as the Serial Annuity plan. Of $1,500,000 bonds bearing date of Aug. 1, 1916, Series A, amounting to $90,000, becomes due Aug. 1, 1919; Series B, amounting to $94,000, becomes due Aug. 1, 1920. Each year the amount retired exceeds the amount retired the previous year, so that the last payment, Series M, which becomes due on Aug. 1, 1931 (15 years from the date of issue), amounts to $144,000. The interest on the outstanding indebtedness is paid each year; the total payments are practically the same each year. The same method of retirement was also adopted for the $1,500,000, bearing date of Feb. 1, 1917.

Bonds Limited to Life of Improvement

New Jersey and Delaware are the only states in which the terms of bonds is limited to the probable life of the improvement for which the bonds are issued. The term of municipal bonds in New Jersey is fixed by the law of 1916 as follows: For stone, concrete and iron bridges, 30 years; for roads and streets built of concrete 6 in. thick or of block of any material or sheet asphalt laid on concrete foundation, 20 years; for bituminous concrete construction, 15 years; for waterbound macadam, penetration method, 10 years; and for gravel, 5 years. The New Jersey law also provides that all bonds shall be paid in annual installments, commencing not more than 2 years from the date of issue—in other words, deferred serial bonds. In Delaware 40-year sinking-fund bonds may be issued for state highways, provided they are constructed with such materials that with proper maintenance they may be expected to last 40 years.

Between 1882 and 1912 the method for bond retirement (sinking fund or serial) was optional in the State of Massachusetts. Since 1912 the use of sinking funds has been prohibited, the serial bond has been made compulsory and the maximum term has been reduced from 30 to 15 years.

Between 1894 and 1904 the state highway bonds of Massachusetts were issued with sinking-fund provisions. From 1905 to the present time, serial or deferred serial bonds have been issued. All of these bonds, amounting to about $8,700,000, bear not less than 3% and not more than 4% interest.

California Issues 50-Year Bonds

California state highway bonds authorized in 1910, and amounting to $18,000,000, were issued as deferred serials, with the maximum term of 50 years. Additional state highway bonds, amounting to $15,000,000, authorized in 1916, are to be issued under the same conditions.

The $2,000,000 state highway loan authorized by the legislature of Utah during the early part of 1917 is to be retired by the serial method and in not to exceed 20 years.

As indicated above, the tendency in some of the states during the past few years has been to adopt serial bonds and to reduce the term of the debt somewhat in proportion to the life of the improvement. The case of New York, however, may be cited as a striking exception to this tendency. The New York state highway bonds authorized in 1906 and 1912 respectively, for a total of $100,000,000, were issued with sinking-fund provisions. These bonds bear from 3 to 4½% interest, and are to run 50 years before any of the bonds are retired.

Types of Bonds

The various types of bond may be briefly described as follows:

Sinking-Fund Bonds—Under the sinking-fund plan, none of the bonds are retirable until the end of a definite period, and the entire sum raised bears interest for the entire life of the bond. The county or municipality pays interest on the money so borrowed and in addition sets aside each year, as a sinking fund, an amount which when invested at compound interest will be sufficient to retire all the bonds when they become due.

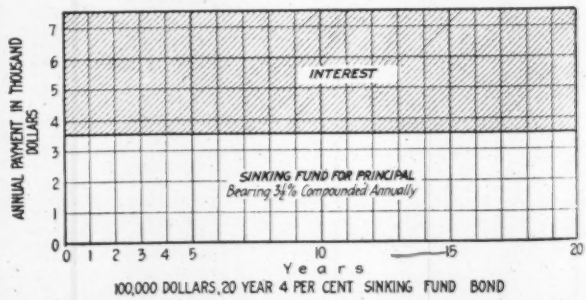

INTEREST
SINKING FUND FOR PRINCIPAL
Bearing 3½% Compounded Annually
ANNUAL PAYMENT IN THOUSAND DOLLARS
Years
0 1 2 3 4 5 10 15 20
0 1 2 3 4 5 6 7
100,000 DOLLARS, 20 YEAR 4 PER CENT SINKING FUND BOND

FIG. 2. SINKING FUND BONDS BEAR INTEREST ON FULL SUM FOR WHOLE LIFE

The method of disposing of a 20-year sinking-fund bond is shown graphically by the chart, Fig. 2.

In this particular case the bonds bear 4% interest and the sinking fund brings 3½%, compounded annually. The annual payment for interest amounts to $4000, or a total of $80,000, and the annual deposit for sinking fund amounts to $3536.10, or a total of $70,722, making a grand total for interest and sinking fund $150,722.

Annuity Bonds—The annuity bond is similar to the method employed by home buyers in large cities, by which they pay a fixed amount each month, a portion of which is used to pay interest, and the balance is applied on the mortgage. The annuity method is similar to the sinking-fund method in that the total outlay for the payment of interest and principal remains constant each year from the time the bonds are issued until they are paid off. The amount paid for interest, however, is relatively large at first, and consequently the annual payment on the principal is relatively small; but as the principal is gradually paid off the annual interest charges diminish. This is brought out graphically in Fig. 3, which represents a $100,000 4% 20-year annuity bond.

In this case the total outlay for interest and principal the first year would be $7358, of which $4000 would be for interest and $3358 for principal. The second year

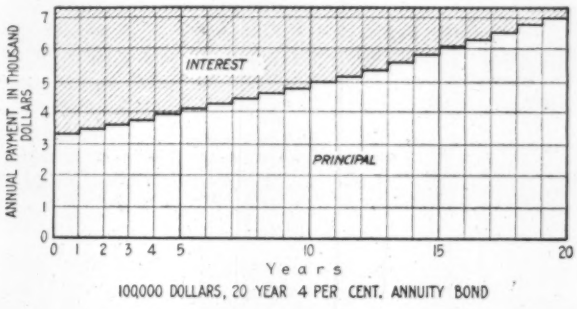

ANNUAL PAYMENT IN THOUSAND DOLLARS
INTEREST
PRINCIPAL
0 1 2 3 4 5 10 15 20
Years
100,000 DOLLARS, 20 YEAR 4 PER CENT. ANNUITY BOND

FIG. 3. INTEREST PAYMENTS DECREASE ON ANNUITY BONDS

the interest would amount to $3866, and the payment on principal would be $3492.50, and so on to the twentieth year, when $283 would be the interest charge, and $7075 would be the final payment on principal, making in all $147,163.50, of which $47,163.50 would be the interest charge.

The formulas used in computing bond issues by the sinking-fund and annuity methods are contained in Bulletin No. 136 of the United States Department of Agriculture, which may be easily obtained.

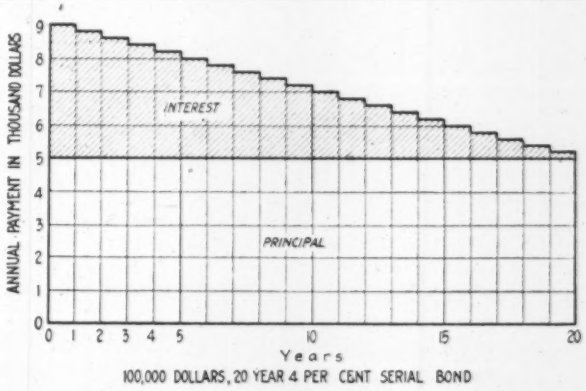

ANNUAL PAYMENT IN THOUSAND DOLLARS
INTEREST
PRINCIPAL
0 1 2 3 4 5 10 15 20
Years
100,000 DOLLARS, 20 YEAR 4 PER CENT SERIAL BOND

FIG. 4. SERIAL BONDS LESSEN INTEREST PAYMENTS

Serial Bonds—In the codicil to Benjamin Franklin's will, written in 1789, he left $5000 each to the cities of Philadelphia and Boston, to be invested for two centuries, the income to be lent to young married artificers. These loans were to be repaid in ten equal annual installments, with interest at 5% per annum. Thus Benjamin Franklin was one of the first to recognize the economy and desirability of serial-bond retirement. If the principle laid down by Franklin for the retirement of personal debts were more frequently applied to the retirement of public debts, both state and local, millions of dollars would be saved annually to the taxpayers of the United States.

Under the serial plan a certain amount of the bonds is retired each year, the interest on the remaining amount outstanding is paid, and the bonds retired cease to be an interest charge on the community. The method of retiring $100,000 of 20-year 4% serial bonds is shown graphically by Fig. 4.

In this case, $5000 would be paid on principal each year. The interest for the first year would be $4000; for the second year, $3800, and so on, decreasing by $200 each year, until the twentieth year, when $5000 on principal and $200 on interest would dispose of the debt. The total outlay would be $142,000, of which $42,000 would be for interest.

From the above it will be seen that when a county issues 20-year bonds under the conditions given, it would save $3559 for each $100,000, by using the annuity method, or $8722 by using the serial method, instead of the sinking-fund method; but when the interest rate is higher than 4% and the term is longer than 20 years the saving would be considerably greater.

A set of curves showing the total cost of $100,000 of bonds bearing interest at 3, 4, 5 and 6% by these three

Annual Costs of Three Kinds of Bond

TABLE I. ANNUAL COST OF SINKING-FUND BOND

Average annual cost of a $100,000 sinking-fund bond bearing 3, 4, 5 or 6% interest, with sinking fund drawing 3½% interest, and bonds maturing at different periods from 5 to 50 years.

Term in Years	3%	4%	5%	6%
5	21,648	22,648	23,648	24,648
10	11,524	12,524	13,524	14,524
15	8,183	9,183	10,183	11,183
20	6,536	7,536	8,536	9,536
25	5,567	6,567	7,567	8,567
30	4,937	5,937	6,937	7,937
35	4,500	5,500	6,500	7,500
40	4,183	5,183	6,183	7,183
45	3,945	4,945	5,945	6,945
50	3,763	4,763	5,763	6,763

TABLE II. ANNUAL COST OF ANNUITY BOND

Average annual cost of a $100,000 annuity bond bearing 3, 4, 5 or 6% interest, and maturing at different periods from 5 to 50 years.

Term in Years	3%	4%	5%	6%
5	21,835	22,463	23,097	23,741
10	11,724	12,329	12,950	13,586
15	8,377	8,994	9,634	10,296
20	6,722	7,358	8,024	8,718
25	5,743	6,401	7,095	7,823
30	5,102	5,783	6,505	7,265
35	4,654	5,358	6,107	6,897
40	4,326	5,052	5,828	6,646
45	4,085	4,826	5,626	6,570
50	3,887	4,655	5,478	6,344

TABLE III. ANNUAL COST OF SERIAL BOND

Average annual cost of a $100,000 serial bond bearing 3, 4, 5 or 6% interest, and maturing at different periods from 5 to 50 years.

Term in Years	3%	4%	5%	6%
5	21,800	22,400	23,000	23,600
10	11,650	12,200	12,750	13,300
15	8,267	8,800	9,333	9,866
20	6,575	7,100	7,625	8,150
25	5,560	6,080	6,600	7,120
30	4,883	5,400	5,917	6,434
35	4,400	4,914	5,429	5,943
40	4,037	4,550	5,063	5,576
45	3,756	4,267	4,778	5,289
50	3,530	4,040	4,550	5,060

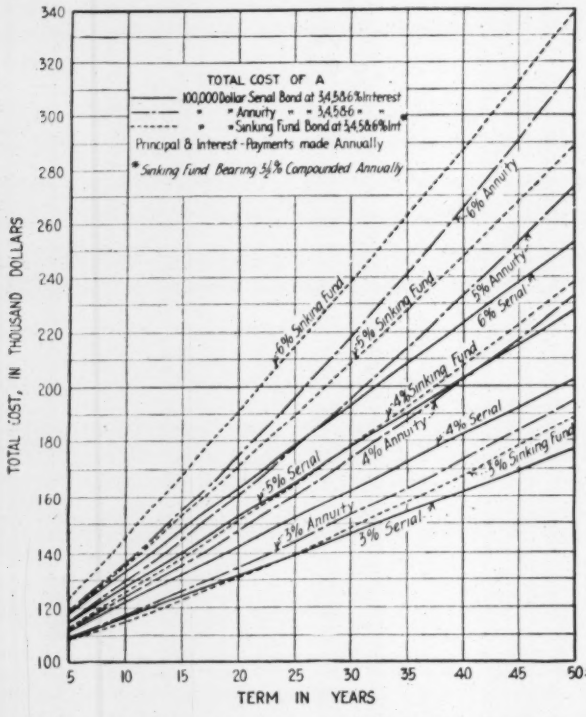


FIG. 5. RELATIVE COSTS OF VARIOUS BOND TYPES

methods to be paid off at the end of any year from the fifth to the fiftieth year is shown by Fig. 5. The sinking-fund bond curves are computed on the theory that the sinking fund brings 3½% interest compounded annually. The economy of the serial bond is strikingly shown by these curves. The exact figures on which the curves are based are presented in Tables 4, 5 and 6.

An examination of the curves will show that a serial bond bearing 5% interest will cost approximately the same if paid off at the end of the forty-first year as a 4% annuity bond retired at the same time. If the bonds are paid off at any time after the forty-first year, the 4% annuity bond would be more expensive than the 5% serial. The 5% serial will cost approximately the same as the 4% sinking fund, if they are both paid off at the end of the twenty-eighth year.

Why the Sinking-Fund Method Is Bad

The chief objection to the sinking-fund bond is that its principles are so frequently violated, sometimes wilfully and deliberately, and sometimes through ignorance. The strongest argument against sinking-fund bonds is the wanton mismanagement which so frequently accompanies the handling of the sinking funds. It is not uncommon for counties to issue long-term sinking-fund bonds without providing a sinking fund for the retirement of the bonds when they may become due, and at the end of the term to issue refunding bonds on the same basis. In such cases, the total outlay for interest, before the debt can be canceled, may amount to twice or three times the original cost of the work performed.

No individual could acquire a sound financial reputation in the community, if he continually renewed his indebtedness. The same is also true to a certain extent of a corporation or a body politic. That millions of dollars of refunding bonds are issued annually in the United States is a proof that the sinking-fund method of financing is unsound.

Danger of Mishandling the Sinking Fund

Numerous cases might be cited of counties and municipalities which have made poor use or no use at all of the sinking fund. The existence of a sinking fund is a constant temptation to local officials to use it for purposes other than the purposes for which it was intended. The sinking fund will not progress satisfactorily unless it receives constant and careful attention, which may not always be possible in counties where local officials are frequently changed. Hon. John Weeks, of Massachusetts, in a speech in the United States Senate on Feb. 22, 1917, made the statement: "Public sinking funds have proved too precarious for sound financing."

If a county has issued sinking-fund bonds, it should make it an inflexible rule to deposit annually in the sinking fund a pro rata amount sufficient to retire the bonds at maturity. If a sinking fund is created by the law that creates the debt, a public creditor has an assured method of securing payment, and if the sinking fund is created this usually necessitates the levying of an annual tax for the purpose. Unless required by law, the levying of this tax is frequently overlooked by public officials who desire to establish a reputation for economy; and even if the tax is levied and a sinking fund is established, the funds in many cases have not been properly and promptly invested, while in other cases the funds have been used to pay current expenses, or for other improvements, and when the day of reckoning comes insufficient funds, or no funds at all, are available to meet the obligation.

Some Features of Serial Bonds

About the only advantage which the sinking-fund bond has over the serial bond is that the annual payments for interest and principal remain constant each year from the date of issue to the date of payment. The annuity bond, however, possesses the same advantage, and at the same time is not so expensive as the sinking-fund bond, although more expensive than the serial bond.

Under either the sinking-fund or the annuity plan, a uniform tax rate covering a period of years will pay the interest and retire the bonds as they become due, provided the assessed valuation remains constant. However, as taxable valuations usually increase rapidly after extensive improvements have been made, there does not appear to be any particular advantage in a uniform tax rate. The rate will naturally adjust itself to the valuation and to the needs of the community.

The only real disadvantage of a serial bond is that the annual payment for principal and interest is relatively large at first, necessitating a relatively high tax rate, which, however, is gradually reduced to a minimum as the bonds are paid off. But the economy of the serial bond far outweighs this disadvantage.

It is generally believed that a sinking-fund bond will sell to better advantage than a serial bond. That this is not always true, however, is shown by the fact that the first issue of New York City serials, made in 1915

and amounting to $24,000,000, obtained a higher premium than a 50-year sinking-fund issue of $46,000,000 floated at the same time.

The selling price of a bond depends upon several factors. If a bond bears 5% interest and the bond buyer wishes to make 5% interest on his investment, he cannot afford to pay more than par. Under such circumstances the bond would naturally sell at par. If he wishes to make more than 5%, he cannot afford to pay as much as par, in which case the bond would sell at a discount; while if he is willing to make less than 5%, he can afford to pay a premium. The amount of premium that he can afford to pay will depend upon the term, the interest rate, the character of the bonds, the condition of the bond market and the degree of credit or security which the community selling the bonds can offer.

Example Shows Value of Serial Bonds

Assuming an issue of $100,000, 20-year bonds, bearing 5% interest, and that the bond buyer is willing to make 4½% interest net, which condition may be considered typical, then the bond buyer can afford to pay a premium of about $3884, if the bonds are issued as serials, or $6504, where the loan is paid off at the end of the term, such as a sinking-fund bond. Tables VII and VIII show the premium which the bond buyer can pay where he is willing to net from 4 to 5½% interest on bonds which bear from 4 to 5½% interest for each of the two types above referred to, where the term is 20 and 25 years. These figures are based on formulas contained in Bulletin 136 of the United States Department of Agriculture and on the theory that the interest is paid annually.

TABLE VII. PREMIUM ON BONDS RETIRED AT EXPIRATION

Premiums on $100,000 bonds which are retired at the end of 20 or 25 years, with interest paid annually

Term of Bond	Interest Rate of Bond	If Bond Buyer Nets 4%	4½%	5%	5½%
20	4%	0	$6,503.97*	$12,462.21*	$17,925.57*
20	4½	$6,795.16	0	6,231.10*	11,950.38*
20	5	13,590.33	6,503.97	0	5,975.19*
20	5½	20,385.49	13,007.94	6,231.10	0
25	4	0	7,414.10*	14,093.94*	20,121.89*
25	4½	7,811.04	0	7,046.97*	13,413.93*
25	5	15,622.08	7,414.10	0	6,706.96*
25	5½	23,433.12	14,828.21	7,046.97	0

* Discount.

It will be seen from the above that sinking-fund bonds possess, in the cases referred to, a slight advantage over serial bonds, in so far as the premium is concerned. But by subtracting the premiums from the total cost in both cases it appears that the serial bond still has the advantage from the taxpayer's standpoint. For instance, if the premiums are deducted, the total cost of the 20-year 5% serial above referred to is $15,602 less than the 20-year straight terminable bond, and for the 25-year bond the serial has the advantage over the straight terminable by $21,292 for each $100,000 of bonds issued.

Sinking-Fund Bonds Are Still Widely Used

The most desirable and economical type of bond for county road and bridge work appears to be the serial form. It is not always advisable, however, to begin paying off a bond the first year of the loan. The financial obligations of a county should be so arranged as to make the burden comparatively light at the very outset, thus giving the people a chance to develop their resources, adjust themselves to the new conditions and realize some of the advantages from the improvements before beginning to liquidate the debt. This may be done by deferring the first payment from three to six years. Even if this is done and the interest on the debt before liquidation begins is added to the total cost, the serial bond is ordinarily more economical than the sinking-fund bond.

TABLE VIII. PREMIUM ON BONDS RETIRED ANNUALLY

Premiums on $100,000 bonds with terms of 20 and 25 years, which are retired by equal annual payments, with interest paid annually

Term of Bond	Interest Rate of Bond	If Bond Buyer Nets 4%	4½%	5%	5½%
20	4%	0	$3,884.48*	$7,537.79*	$10,976.75*
20	4½	$4,006.05	0	3,768.89*	7,317.83*
20	5	8,012.09	3,884.48	0	3,658.92*
20	5½	12,018.14	7,768.96	3,768.89	0
25	4	0	4,520.80*	8,724.84*	12,639.35*
25	4½	4,688.96	0	4,362.42*	8,425.23*
25	5	9,377.92	4,520.80	0	4,213.12*
25	5½	14,066.88	9,041.59	4,362.42	0

* Discount.

There are only 10 states in which serial bonds are specifically provided by law for local road and bridge work. The general bonding laws of 15 states provide for sinking-fund bonds, and in four of them the bonds may be issued subject to call. In 13 states the laws are indefinite as to the class of bonds that may be issued. There are 10 states in which practically no bonds are issued for local road and bridge purposes.

On Jan. 1, 1915, the total local road and bridge bonds outstanding in the United States, exclusive of cities, amounted to approximately $230,000,000. It is estimated that at least $160,000,000 of these bonds were of the sinking-fund variety; that the average term was 25 years; and that the average rate of interest was 5%. If these bonds had been issued as serials, for the same term and bearing the same rate of interest, it would have resulted in a total saving of approximately $42,000,000, or an average annual saving of $1,680,000.

Grade Separation or Protected Grade-Crossing

From an economic point of view a railway grade-crossing protected by an interlocking plant and signals may be more advantageous than a separation of grades. This was a decision in the location of the new cutoff of the Northern Pacific Ry. between Logan and Bozeman, described in the *Engineering News-Record* of July 19. A correspondent in calling attention to the grade crossing suggested that it appeared as though this might be avoided easily by changing either the location of the new line or the profile of the old line, at a cost probably well within 5% of the total cost of the improvement.

In reply to this, H. E. Stevens, Chief Engineer of the Northern Pacific Ry., states that this point was considered very carefully and that several preliminary lines were run. It is possible to make a grade separation at an expense of about $175,000. But as the new line is for freight operation only, and the crossing is fully protected by an interlocking plant and the automatic block signals on the existing line, the company did not consider this additional expense was justified. The separation can be made equally well at a later time, in case the density of traffic should increase to such an extent as to warrant the large expenditure involved.

Army Cantonment at Louisville Laid Out Like Suburban Development

Planning of Roads, Sewers, Water-Works and Proper Orientation of Buildings Required Much Preliminary Engineering—Water Supply Obtained from City of Louisville's System

By NATHAN C. ROCKWOOD
Associate Editor, "Engineering News-Record"

WHEN the National Army camp site just outside the city limits of Louisville, Ky., was decided upon, there existed only a United States Geological Survey map of the county on a scale of 1000 ft. to the inch. The topography of this site, known as Camp Taylor, is more irregular and picturesque than that of most of the other camp sites and therefore required correspondingly more preliminary engineering. This work was done in the astonishingly short period of 12 days, between June 18 and July 1.

Work from Map Enlargement

In order that construction work might start immediately, the Geological Survey map was enlarged by photostat to a scale of 400 ft. to the inch. On this photostat map the main features of the cantonment were blocked out; that is, the location of groups of buildings and the main scheme for streets and sewers. From this rough plan some of the buildings and main trunk sewers were staked out and construction work begun. In the meantime an engineering corps of fifty men was put into the field under the supervision of James B. Wilson, superintendent and chief engineer of the Louisville Water Co., who is consulting engineer in charge.

Working with transit and stadia, these men completed in 12 days a topographic survey of 2300 acres of rough country in and surrounding the camp site.

Almost as fast as the notes were recorded, they were plotted by a squad of draftsmen on two maps, one on a scale of 400 ft. to the inch and the other on 200 ft. to the inch. The field men worked from 8 a.m. until dusk, and the draftsmen worked until 10 p.m. The draftsmen were paid at the rate of 50c. per hour, three chief draftsmen 75c. an hour.

At the end of the 12 days the two 5-ft. contour maps were completed and the 200-ft. to the inch map was adopted as the working plan. A reproduction of this map was published in *Engineering News-Record* of July 26, p. 154. Since this first plan was completed, revisions have been made, but the main scheme as shown on that plan has been generally carried out.

Some Real City Planning

Unlike most of the other cantonment sites, the topography of the Louisville camp gave an opportunity to develop some real city planning; and H. P. Kelsey, of Cambridge, Mass., has given his whole time to this work for several weeks. He lives on the job and has taken great pains to see that his plans are carried out. These plans have involved not only utility, but, so far as commensurate with rapidity and economy of construction, attractiveness in the scheme of building layout. Trees and grass plots are plentiful and the site is such as to require little or no attention to artificial surface drainage by unsightly and mosquito-breeding open ditches.

The buildings in many cases are on grassy knolls, and

THE CAMP SITE OFFERED UNUSUAL OPPORTUNITIES FOR LANDSCAPE TREATMENT

with trees and little valleys the landscape is probably one of the most attractive to be found in any of the army cantonments. All these features have been considered in Mr. Kelsey's layout, notwithstanding the fact that work has been pushed at top speed. The object has been accomplished only by constant revisions of the original layout before starting construction.

Sewerage System Complicated by Hills and Valleys

The work of planning in a few days a complete sewerage system for a city of 50,000 on rolling ground, covering an area of 2300 acres, was no small undertaking. Since the main drainage and outfall system had been decided upon, work was begun before the completion of the topographic survey. Even after the 5-ft. contour map was completed, a great deal of field work was necessary on the sewer lines before these could be actually staked out satisfactorily.

The method of sewer construction was as follows: From the 5-ft. contour map profiles of proposed sewers

UNLOADING YARDS AT CAMP TAYLOR AND PORTION OF THE ROAD SYSTEM

were plotted and their approximate locations fixed. Field parties were then sent out with these approximate locations, and the exact line was adjusted to the ground so as to give as little cutting as possible; but in some instances 8- to 12-ft. cuts have been necessary. In other instances the original location of the sewers has been changed to avoid any considerable amount of rock cutting. All trenching has been done by hand.

The main drainage of the camp is taken up at the boundary of the cantonment site by a sewer constructed by Jefferson County at a cost in the neighborhood of $50,000. This is a 24-in. pipe sewer, extending for a distance of about one mile, and a 30-in. segmental tile-block sewer continuing another mile, through the Beargrass Creek Valley to a junction with the Beargrass intercepting sewer of the City of Louisville. Segmental tile block were used in this case because pipe of that size was almost impossible to obtain at the time it was needed. This mile of larger sewer is to take the drainage of one of the city suburbs, but the remaining part of the sewer was built only for the cantonment.

The water-supply of the camp is furnished by a 12-in. main connected with the city mains of the Louisville Water Co., a municipally owned corporation. The 12-in. main leads to a 200,000-gal. storage reservoir of four wood-stave tanks. From these the water is pumped directly into the camp mains by centrifugal pumps. The water mains of the camp site proper are practically all of wood-stave pipe. The main connecting to the city water-supply is cast iron, and all the fittings at the pumping station are, of course, cast iron. The pumping station itself is set enough below ground so that no elbows are required in the pump discharge, the pumps being set at the same level as the outgoing mains. This was done chiefly to save using any special fittings, which at this time are extremely difficult to get.

THE CAMP ROADS HAVE A 6-INCH MACADAM BASE AND A 2-INCH ASPHALTIC CONCRETE SURFACE

Ten Miles of Asphalt Pavements

There are 5 miles of 18-ft. main roads in the camp site and 5 miles of 16-ft. secondary roads, not including company streets. The secondary roads in every case lead to the rear of the barracks. Besides these there are three existing county roads which border or cross the cantonment site, but these will be largely superseded by the new and more direct roads.

The cantonment roads are constructed of a base of 6-in. waterbound limestone macadam with a 2-in. asphaltic concrete surface. It has been found in many cases that 6 in. of base is not sufficient, and more than this has been used where necessary.

There are two quarries and two stone-crushing plants on the cantonment site, capable of producing about 700 cu.yd. of crushed rock per day. The asphaltic concrete mixture is furnished by a Louisville paving company, and is trucked to the camp site from the city. Both Bermudez and Mexican asphalts of from 40 to 60 penetration have been used.

On some of the roads grades as high as 8% have been necessary. In no instance have sewers or water mains been laid under the pavements except at crossings. The estimated cost of these pavements was $12,000 per mile, but the actual cost has run 30% above this estimate.

The roads of this cantonment are an essential part of it, for all transportation within the camp is by motor trucks and teams. Construction materials are brought to one end of the site and are moved over the roads of the cantonment. The United States Army Quarter-

THE U. S. ARMY QUARTERMASTER DEPARTMENT HAS SIXTY 1½-TON MOTOR TRUCKS ON THE JOB

master Department alone has sixty 1½-ton Packard motor trucks on the job, and practically every available motor truck in Louisville has been in the service of the contractor during construction.

The construction of the roads of the camp is under the supervision of W. F. Brooks, detailed for this work by the U. S. Office of Public Roads and Rural Engineering. The contractor for the road work is the Henry Bickel Co., of Louisville.

The contractors for the main part of the cantonment, Mason & Hanger, of Lexington and Richmond, Ky., have organized the work under a general superintendent, T. E. Coleman, into 22 sections, each section in charge of a superintendent. Under each superintendent is a boss carpenter. The sewer construction is looked after by a superintendent of the sewer division, P. W. Earley. The contractor's office engineer is W. E. Gore, formerly an architect of Louisville. The chief engineer for the contractor is A. J. Sackett. For the Government Maj. F. E. Lamphere is constructing quartermaster.

During the first week in August, when work had been organized to its maximum efficiency, fully 5000 men were employed on construction. Wages paid are somewhat less than those paid farther north, being 30c. an hour for ordinary labor, 50c. an hour for carpenters, and $7 a day for team and driver.

Toledo Has High-Pressure Fire Protection System

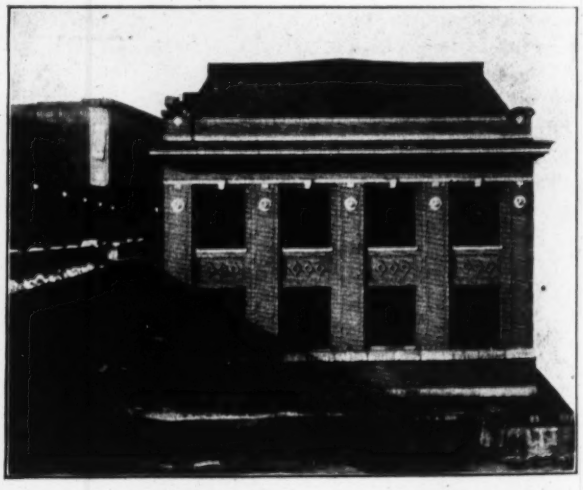
Motor-Driven, Five-Stage Centrifugal Pumps Force River Water at 300 Lb. Pressure Through Four Miles of Pipe

EARLY in the present year the City of Toledo, Ohio, put in operation a high-pressure fire-protection service covering 140 acres of the business district of the city, affording the most modern protection that was available.

The good-looking pumping station shown herewith is conspicuously located on the Maumee River close by the Maumee bridge. For the sake of appearance and to gain space to house a municipal department, a second story was added to the building. Otherwise its roof would have been but little above the bridge level. The building is 65 x 90 ft. in plan, with bearing walls of brick and reinforced-concrete floors. In most details the construction follows standard practice.

Four motor-driven five-stage Allis-Chalmers centrifugal pumps have been installed, and space for two more is provided. Each pump has a capacity of 2000 gal. per minute against a pressure of 300 lb., at about 1500 r.p.m. The motors are rated at 550 hp. each. Current is bought by the city. Venturi meters with recording rate-of-flow and total-flow gages have been set in each of the two 16-in. discharge mains. Raw water is taken from the Maumee River, and complete separation is maintained at all times between the regular system and the high-pressure lines.

The distribution system includes 22,500 ft. of 10-, 12- and 16-in. extra-heavy (Class G, Am. W.-W. Assoc.) cast-iron pipe. There are 67 post hydrants, each with



THE LOCATION OF THE PUMPING STATION DEMANDED A GOOD-LOOKING STRUCTURE

four independently gated 3½-in. outlets, with double caps reducing to 2½ inches.

The cost of the pumping station was as follows: Land, $20,000; substructure, $50,549; superstructure, $57,542; machinery and equipment, $62,834; total, $190,924.

T. R. Cook is water commissioner and George N. Schoonmaker construction engineer. The W. J. Sherman Co., Toledo, prepared the plans for the station.

Raise 4 Miles of Line To Eliminate 21 Grade Crossings

Northern Pacific Work at Spokane, Nearly Completed, Improves Profile but Involves 2-Mile Runoff at West End

AN ASCENDING ruling grade, uncompensated for curvature, as the west approach has added materially to the cost to the Northern Pacific Ry. of eliminating its grade crossings at Spokane, Wash. Holding to the same ruling grade, but with compensation for curvature, the runoff extends 10,000 ft. beyond the last grade crossing on the former profile and involves an average elevation for two tracks of about 10 ft. Through the heart of the city, where the crossings were numerous, the average fill is about 16 ft., the street grades at most of the 21 bridges being changed but slightly. The work has been under way for four years and is nearly completed. It has cost approximately $2,500,000.

The accompanying map and profile show the main outlines of the work. The Northern Pacific as originally built followed the contour of the ground very closely through Spokane, the town being some distance from the tracks. Now, however, the business section of the city is very close to the railroad and extends from Division St. to Cedar St. At the time the improvement was started a number of the grade crossings were very busy, the worst being at Division St. and Sprague Ave., where a double-track street-car line crossed the throat of a freightyard. The main tracks through the business section were flanked by industries. At Fourth Ave., going westward, the line broke into a descent of the valley of Hangman Creek, following a steep hillside.

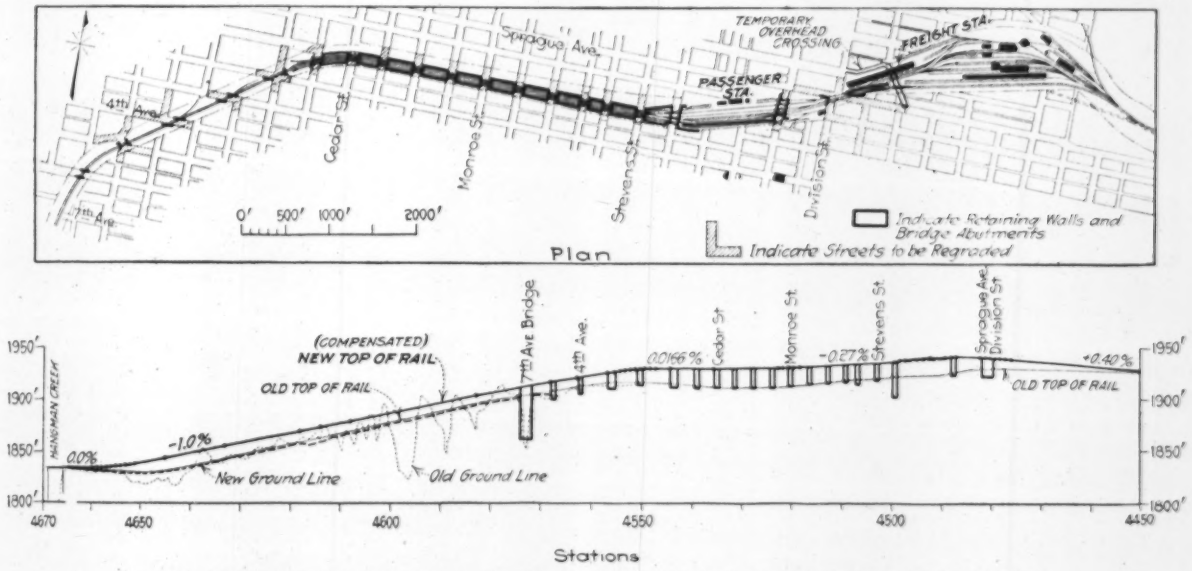
The new profile gives an easy approach at the east end, alongside the freightyard, smooths out the irregularities through the business section and begins the descent along Hangman Creek at an elevation of about 9 ft. above the old profile at Fourth Ave. This is increased to 12 ft. at the bottom of the grade.

Most of the 24 bridges are of reinforced concrete. Some of them are of steel or combinations of steel and concrete, because of restricted clearance on the skew of the crossings. The extent of the street approaches is indicated by the shading.

The company has a 225-ft. right-of-way through the city. All but a 113-ft. strip is under lease to industries, however, and to accommodate these industries it was necessary to make the fill wide enough for six tracks —a switching track and an industry track each side of the two mains—hold the fill with retaining walls and adapt the industries to the use of the outside tracks. The west connections with the local freightyards were cut off by the difference in elevation. The old passenger station has been slightly remodeled to accommodate the new grade.

All Work Under Traffic

All of the construction work was done under traffic. Main-line traffic was carried on two tracks, which, as work progressed, were shifted from one side of the fill to the other. Service to the industries was maintained by three tracks at the extreme edges of the right-of-way, two on the south side and one on the north, the retaining walls being located at minimum clearance inside these tracks. The main tracks were shifted to one side of the strip between walls, and the opposite walls and half of the bridges were built. Then a temporary pile trestle was built alongside the wall and the fill on this side made. After the main tracks were shifted to the top of the new fill the same procedure was followed for the other side.



PLAN AND PROFILE OF NORTHERN PACIFIC GRADE-SEPARATION WORK AT SPOKANE

At the freightyard a pile bridge 1200 ft. long, passing over the freighthouse, was built to carry street cars and the heavy vehicular traffic of Sprague Ave. Its location is indicated on the plan.

Construction was begun in November, 1912, on the Hangman hill grade raise. A contract for all concrete work and street grading was let in January, 1913, but soon after this work started injunction proceedings by abutting property owners held it up for about two years.

TWO TRACKS UP, THE OTHERS DOWN—ABUTTING INDUSTRIES HAMPER CONSTRUCTION OPERATIONS

The work is now, as previously stated, nearly completed.

The W. J. Hoy Co., of St. Paul, is the general contractor. The concrete work has been sublet to the Pacific Concrete Placing Co., of San Francisco. The track work and railroad grading are being done by company forces. The work has been done under the supervision of W. L. Darling and his successor, H. E. Stevens, as chief engineer of the Northern Pacific Ry. Mr. Stevens, when bridge engineer, had charge of the drawing up of the bridge plans, while M. F. Clements, who last November succeeded Mr. Stevens as bridge engineer, was before that assistant engineer in direct charge of the construction.

Prison Labor and Slag Surfacing Solve Ohio Road Problem

Mahoning County Overcomes Labor Shortage in Road Work by Using Convicts—Blast-Furnace Slag Makes Good Surfacing

MAHONING County, Ohio, has found a practicable way to meet labor shortage. All able-bodied prisoners in the county jail with sentences of from 10 days to 3 months are given jobs on the county roads. About 60 prisoners are thus employed continuously. The guards are sheriffs' deputies who also act as road foremen; in fact, they are picked because of their practical knowledge of road construction. The prisoners are taken back and forth from the jail to their work every day in motor trucks. It costs the county about 98c. per day for the support of the prisoners, and the county pays them $1.50 a day for their labor, giving them a better opportunity to work off their fines than in any other way.

The efficiency of this labor on waterbound macadam construction is said by the county engineer, Ett S. Smith, to be practically equal to that of the county's regular force-account gangs; but whether this is characteristic of the efficiency of present-day labor in general or merely an extraordinary degree of efficiency in prison labor is not clear. Once in a while the prisoners voluntarily stick to the roadwork when they are given their liberty, for they have an opportunity of earning 35c. an hour by doing so.

Early in the season an experiment was made of letting out prison labor to contractors, but the experiment proved unsuccessful and all the work is now done by the county in the same manner as force-account work, except that the foremen (or guards) are armed with shotguns to compel the laborers to stick to their jobs. About two guards are required to a gang of 20 men.

The employment of county prisoners for highway construction was made possible by a state law which went into effect about a year ago, and the county commissioners of Mahoning County have been among the first to take advantage of this law.

Meeting at the onset of the season's work with bids of $35,000 a mile for brick pavement construction and

MAHONING COUNTY PRISONERS ON THEIR WAY TO ROADWORK

with correspondingly high prices for concrete work, the county commissioners and their engineer decided to devote all their energies to the construction of waterbound and bituminous macadam roads, making use of the enormous amount of blast-furnace slag which is produced in this district. It was decided that the all-important thing to accomplish was to get hard surfaces on as many of the rural roads as possible and to use the

GANG OF 20 PRISONERS ON MAHONING COUNTY ROADWORK

most economical construction under the present conditions.

The intention is to ultimately resurface the macadam with brick or concrete, as has already been successfully done on a number of the older improved roads. Several excellent brick pavements in the county have been constructed on old slag macadam bases and a sand bedding or cushion. Many of the old macadam roads are also being resurfaced with 2 in. of tar concrete. Altogether, some 30 contracts have been let the present season in this county, and work is proceeding at a practically normal rate.

The use of slag makes it possible to get material for macadam, which in less fortunate parts of the state is as difficult to get as are shipments of brick and other construction materials. The only reason why the contractors on the Mahoning County roadwork get their material promptly is because all the steel mills in this vicinity use the pit method of slag disposal, and the slag must be removed constantly to keep the plants going, so that very powerful interests are at work to bring about prompt railway service.

Water-Filtration Costs at Grand Rapids Increased 31% in a Year

The total operating cost of water filtration at Grand Rapids, Mich., was 31.1% higher in 1916-17 than in the previous year, but an increase of 13.6% in pumpage reduced the cost per 1,000,000 gal. to 15.6% higher than it was in 1915-16. Higher prices for labor and chemicals and an 85% increase in the alum rate contributed to the higher cost.

The use of more alum, says Walter A. Sperry, chief chemist of the filter plant, in his annual report, was due to "continued efforts to secure a more satisfactory water" and also to "more severe seasonal changes this spring as compared with last."

Lime cost $6.49 per ton in 1916-17 as compared with $5.81 the year before; alum, $21.92 compared with $19.98 in 1915-16 and $17 in both 1914-15 and 1913-14; hypochlorite of calcium, $4.32 in 1916-17 compared with $2.24 in 1915-16, $1.70 in 1914-15, and $1.75 in 1913-14.

The percentage of wash water for 1916-17 was 2.1%, as an average for the whole year, the range being from 3.2% in August to 1.6% in September and in February. In the previous year the wash water was 1.9%, in 1914-15, 2.1%, and in 1913-14, 3% of water treated.

The net cost of filtration in 1916-17 was $15.20 per million gallons, compared with $13.12 the previous year, and $11.57 the year before. The figure $15.20 was divided as follows: Wages, $4.35; chemicals, $7.53; electric current, $2.31; supplies and repairs, $1.

Tunnel from Below To Build Diversion Dam

In This Self-Cleansing Dam in Hawaii the Main Wall Was Formed by Successive Tunnels Filled with Concrete

IN BUILDING diversion dams on certain flashy streams in the Hawaiian Islands great difficulty has been found in keeping headgates clear of boulders, gravel, sand and other débris carried down by floods. Ordinary diversion dams are often totally covered up in a few minutes by tons and tons of matter which takes days to remove. In some cases even, where the gorge is a wide one, the owner finds his diversion dam covered up and the stream bed moved several hundred feet away.

In looking over some such dams, a Hawaiian engineer, J. C. Foss, Jr., of Hilo, Hawaii, came across a small dam built by a ranchman where a downstream pool operated to relieve this difficulty. This ranchman had found natural water holes located at the foot of small waterfalls, which holes stored a limited amount of water. When a dam was thrown across the lower end of the water hole to make an increased reservoir, the next storm flow would deposit boulders and gravel in the hole, often completely filling it. The rancher solved the problem by raising the crest of the waterfall at the same time he raised the water-hole dam below. He found that it worked out best to raise the waterfall crest three times as much as he raised the dam, as the débris would be given additional acceleration and be carried into and out of the water hole at storm times. When the stream subsided and stopped carrying débris, the water holes would be left clean and filled with water.

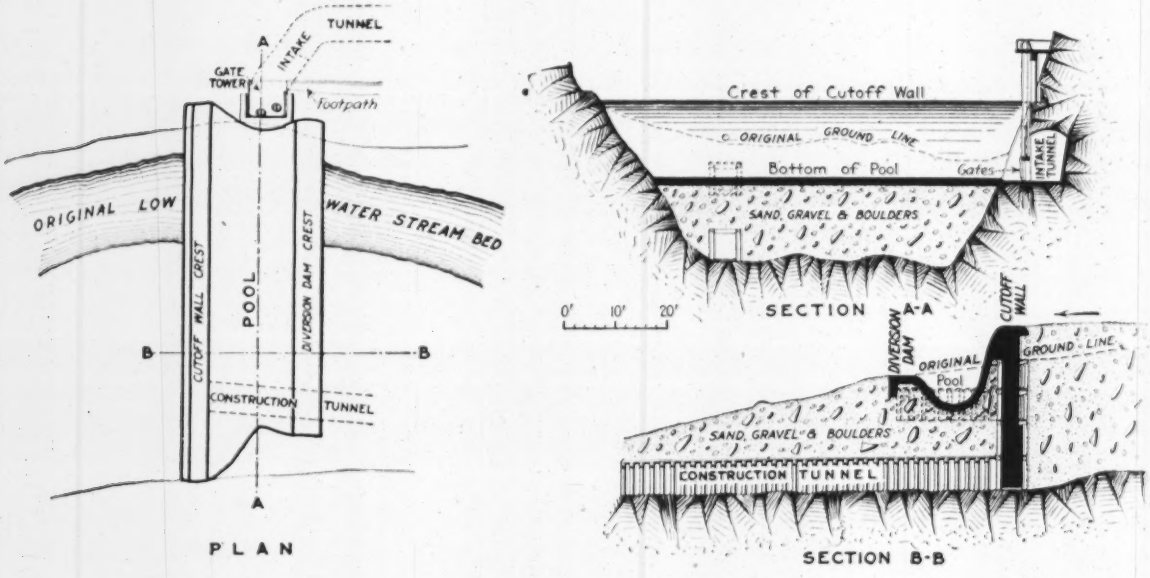
Poor Subsurface Prevented Open Trench

It occurred to Mr. Foss that this type of dam might be used on a larger diversion dam which he was then building. He then proceeded to utilize the scheme described below.

At this site there were frequent floods, about twice a week, and the stream carried heavy boulders, brush and gravel when flooded. The formation at the dam site was a very porous rock, sand, gravel and boulder mixture, extending down to bedrock about 25 ft. below. In normal conditions the loss of water through this stream bed amounted to nearly 20%, a very serious loss at the headgate.

The first idea was to dig a trench across the gorge, fill that with concrete elevated above the normal ground level, and then prepare a pool below the elevated crest so formed. It was soon found, however, that the frequent floods made this construction quite difficult, particularly as there was no satisfactory way of carrying the water around the excavation. It was then that the idea of building the dam from a tunnel below was hit upon.

A tunnel 6 x 6½ ft. in section was started at bedrock well away from the running stream and about 75 ft. downstream from the proposed dam. On bedrock for a floor and with heavy timbering, it was run up the ledge until it reached the cutoff-wall site. Here it was



SELF-CLEANSING DAM IS BUILT BY SUCCESSIVE TUNNELS ONE ON TOP OF THE OTHER

headed across stream, still following the ledge for a bottom, until reaching the other side of the gulch. This tunnel had to be run very carefully on account of the looseness of the material encountered, and great care had to be taken in blasting. At best, the tunnel operation was quite dangerous.

Cross-Tunnel Filled with Concrete

After making proper provision for draining the water, the section of the tunnel at the cutoff-wall site was completely filled with concrete across the gorge, the upper part being placed with heavy irregular protruding stones to make a bond for the next row of concrete. This made the bottom course of the cutoff dam. A stope was then run up to a level above the first cross-tunnel and a higher tunnel carried across the cutoff wall just above the old. The top lagging of the lower tunnel served for the floor of the new one. This second tunnel proved to be more easily excavated than the first, in that the floor was even and enough space had been left between the top lagging and the concrete to take care of most of the water inflow. After the excavation was completed, the lagging and top timbers on the floor were taken up and concrete placed as before.

In running a third tunnel on top of the second, great trouble was encountered in taking care of the water. It could only be worked when the stream was low and could be diverted to one side away from the excavating. Days when the stream was high or at flood, work had to be abandoned. In placing the concrete in this tunnel a water-tight plank floor had to be placed one foot away from the upstream timbers to allow the water to be drained behind it. The section of the concrete was therefore cut down one foot in width. This arrangement was a great help in draining the water while running the next course, and in the judgment of Mr. Foss time and money would have been saved in the first two courses if the same idea had been introduced.

On top of the third lift of tunnel cross-wall, a fourth wall was placed in covered open trench. The top course, which brought the wall up to the stream bed, had to be done in short sections of from 10 to 20 ft. by trenching and immediately filling with concrete.

The next step in construction was the excavating for the pool and diversion dam proper. After starting this excavation, it was decided to return to the cutoff wall and complete the crest, a procedure which aided greatly in keeping the excavation below from filling with débris during floods, but which caused a great deal of anxiety because the engineer was afraid that the pressure back of the wall and the removing of material in front during heavy floods might prove its destruction. The work on the diversion dam, apron and paving the pool was rushed in sections as much as possible, even to working 24 hours a day when the stream was low.

Before the gates into the intake tunnel were placed, careful observation was made as to the action of the diversion-dam scheme under flood water. This was satisfactory as far as leaving the pool clear after a storm was concerned, but just at what elevation to place the higher gate and where to place it so as to get water during floods when the lower gate was shut down was a problem. It was found that the stream did not commence carrying boulders and gravel until the water had risen to over two feet on the lower crest. The upper gate was, therefore, located so as not to side-track boulders going over the diversion dam and at the same time take in enough water to keep the required continuous flow in the ditch.

The only fault found in the completed job was handling such floating débris as ferns, branches of trees, etc. Different kinds of screens placed at the gates all proved to be more trouble than good, so they were removed at this location and placed about 1000 ft. down the intake tunnel line at a suitable crosscut and overflow weir, where they were easily accessible to the ditch tender.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Guarding Against Overstressed Counters in Designing Bridges

Sir—In your issue of July 5, you publish a letter describing a method of designing bridges to guard against overstressed counters. About 11 years ago the writer, then Assistant Bridge Engineer of a great railway system, faced the same problem; namely, developing a set of standard designs in which all bridges of all types would be stressed to an established limit in all parts by the same future increased live-load. The method adopted was to use a basic unit stress of 22,000 lb. per sq.in. for dead-load and 16,000 for live-load and impact.

In practice some of the men added (algebraically) eight-elevenths of the dead-load to the live-load and impact, designing for this sum at 16,000 lb. per sq.in. All the formulas for compression, short cuts for bending, combined load, etc., could then be used without modification. Other men of the department preferred to use the dead-load with eleven-eighths of the live-load and impact at 22,000 lb. per sq.in.; the results were the same. In applying this method to counters eight-elevenths of the direct dead-load shear was considered as acting against the counter live-load shear, or the full dead-load against eleven-eighths of the counter live-load shear, so that future requirements were theoretically provided for.

Any discussion of such a provision for the future is somewhat academic, as it depends for its truth upon a proportional increase of the live-load on the same wheel diagram as that in use at the time the design is prepared. The introduction of the Mallet type of locomotive and of power applied to the wheels of the tender, as well as the increasing use of electric power for heavy duty, have in a great measure annulled the benefits of these efforts to provide for what was then the unknown future. But inasmuch as the structure built today is not for today's use alone, but for many years to come, provision for that future use according to the best indications of the tendency of growth is good practice.

P. E. STEVENS,
St. Paul, Minn. Consulting Engineer.

Well Constructed Farm Entrance Drains Are an Economic Necessity

Sir—I note on p. 181, issue of July 26, an article by Donald A. Thomas, of the Michigan State Highway Department, relative to culverts at farm approaches to improved roads. I believe that the suggestions offered are very good and that the question of such culverts should be governed by fixed standards.

In Adams County, Indiana, we have 700 miles of improved roads serving a total area of 337 square miles. In this area we have 2353 farms nearly all of which have one or more approaches to improved roads. The approaches and culverts are built and maintained by the land owners under the supervision of the highway superintendent. We have found that a 10-in. pipe is the minimum-size culvert that will keep clean. Most culverts are cast or corrugated pipe, as the vitrified or land tile pipes soon break down.

Some of the pipes offered are inadequate; for instance, a 4-in. gas pipe is deemed sufficient by the land owner to carry the water in side drains draining a half mile of road. These installations are condemned by the highway superintendent; and on refusal of the land owner to provide adequate drainage, the entire approach is graded out and the drain maintained as an open ditch. This usually has the desired effect.

The new state highway commission law provides a penalty of $5 to $25 for obstructing the side drains of any state highway, or building approaches that interfere with the highway or the drainage thereof. This penalty is to be collected in the name of the state by a civil action and will no doubt have a good influence on land owners on other than state roads.

R. T. LONGSHORE,
Deputy County Engineer,
Decatur, Ind. Adams County, Indiana.

Why the Railroads Have Not Checked the Hobo

SIR:—The editorial, "Why Can't the Railroads Check the Hobo?" which appeared on page 147 of *Engineering News-Record* for July 26 last, is fairly easy to answer from the railroad standpoint. The various railroads have at different times tried to abate the hobo nuisance, but they have never received assistance from any Governmental authority, and are powerless to combat a virtual combination of local police and hobo. If a hobo is arrested by railroad police and turned over to the local police, the latter make it plain that they do not want him. In fact, the local tramp problem is supposed to be solved when the police make it so hot for them that they catch a freight train out of town. Each community requires the hobo to move on, and any effort on the part of the railroad to prevent him from doing so is frowned upon. If the commission headed by Daniel Willard is sufficiently clothed with authority or through patriotic appeal can gain the coöperation of local authorities in abating the bo nuisance, it will find the railroads ready to do their part. I have known a gang of hobos to cut the air hose and put a freight train out of control because the crew stopped the train and put them off. There are many cases where trainmen were injured in fights with tramps when trying to prevent them from riding. The hobo problem is not one for the railroads to solve, but is a social one requiring the efforts of no less a community than the state, better all the states.

Out on the Union Pacific and other Western roads the bo problem is more acute than in the East, and it was here that I came in intimate contact with it. It would seem proper that those engineers who do not know (including the editor) should be set right.

Cleveland, Ohio. E. C. REYARD.

[Not unmindful of the difficulties outlined above, at the time this editorial was written, it yet seemed that

the best chance to secure concerted action to abate this nuisance was offered by the existence for the first time of a railroad commission with nation-wide authority and close contact with the Government. The initiative must be taken by this commission, as the town governments are so numerous and so utterly unrelated that they can hardly be expected to take concerted action of their own motion.—Editor.]

Bituminous Foundations for Sheet-Asphalt Surfaces

Sir—H. W. Skidmore, engineer, Department of Public Works of Oak Park, Ill., concludes his very able letter on p. 178, issue of July 26, with: "Paving is the contractor's business, not the engineer's particularly. Why should he not come forward with his ideas now and then?"

It is very gratifying to hear from engineers of Mr. Skidmore's broad views who are willing to learn even from a contractor, but our experience has been, as a rule, that suggestions from contractors on the methods of constructing pavements usually meet with direct opposition from the engineering profession. We do not say the best of the engineering profession, because we do not believe this is a fact, but the engineer, like the doctor and lawyer, is supposed to advise his client, and his client is supposed to take his advice. Therefore it becomes necessary, if bituminous-concrete foundations are adopted to any extent, that they come through the engineering profession with what assistance the contractors can offer for carrying out their ideas.

Mr. Kirschbraun's article on page 591 of the issue of June 21, 1917, is a wonderful step forward in this direction, and we predict that in a very few years engineers will be looking backward to this article as the foundation for the biggest step forward in the improvement of bituminous pavements that has been taken in the last 25 years, as it shows practical thought and study coming from a man who has practical construction ideas as well as engineering and general experience.

Summing up the results that can be obtained from the use of bituminous-concrete foundations in comparison with cement concrete, every experienced engineer and contractor must agree that the comparison is as follows:

1. Bituminous foundations laid one day can be completed with the asphalt surface on the following day and the work opened up for traffic almost immediately. Cement concrete must be allowed to set for a week or ten days.

2. Bituminous foundations require only one organization and equipment, whereas cement concrete requires additional equipment and a different organization and the work is necessarily slower in progress.

3. Bituminous foundations mean the elimination of an expensive binder course, thereby deducting 35 to 45% per square yard from the cost of the pavement and even with a binder course it has shown, under extremely heavy traffic, that this binder course of from 1 in. to 1½ in. in depth has not sufficient stiffening ability to absolutely prevent shoving and rolling of the surface.

As a further fact, every civil and chemical engineer and contractor of experience knows, as Mr. Kirschbraun stated, that the heavy and intense traffic on an asph surface laid over a hard unyielding foundation is l the pounding of a plastic material on an anvil, wher the bituminous base gives sufficiently to overcome th crushing force.

Mr. Kirschbraun's statement that "cracks in t foundation of concrete appear in the asphalt surfac is absolutely true, and they would be absolutely obviat with a bituminous base. Further, the statement tha "asphalt pavements disintegrate from the concrete ba upward" instead of from the surface down, as so engineers—mostly laymen—seem to believe, is true.

When it comes to repairs of the ordinary city stree the bituminous base has a big advantage over the cement concrete base in that the base and surface removed can be immediately reheated, retamped into the trench and the bond is absolute and permanent in a few hours, and the replaced trench is ready for traffic.

After 27 years following the game of bituminous paving, and after many discussions with contractors of greater experience and ability, the writer's conclusion is that if the engineers will provide specifications for practical bituminous concrete foundations for asphalt wearing surfaces it will meet with the heartiest coöperation of all asphalt contractors of experience and will solve at least 75% of all the asphalt paving problems—the only exception being where the character of the sub-soil is such that it is not self-sustaining and needs to be made more rigid by the use of portland cement. This can be accomplished by the use of a base of say 3 in. of portland cement, over which will be laid the base proper of bituminous concrete. In rare cases only, however, will this be found necessary.

Any engineer will be repaid by reading Mr. Kirschbraun's article and pasting it in his scrap book for ready reference, as the engineering profession must unquestionably awaken to the fact that this class of foundation is absolutely necessary for long-lived bituminous pavements.

L. B. WEST.
Chattanooga, Tenn. The West Construction Co.

How To Use Limestone Screenings in Concrete

Sir—For several years there has been considerable discussion as to the value of limestone screenings in concrete. The adverse points usually brought forth are that they contain considerable dust and that the particles are coated with an almost invisible material which prevents proper bond. On the other hand there are many examples of first-class concrete in which limestone screenings have been used.

To eliminate the factor of chance, special study should be given to the character of the mix when the fine aggregate consists of limestone screenings. Much will necessarily depend upon the hardness of the limestone which from the screenings are obtained. If the screenings are washed and pass the usual specifications, standard practice can be maintained with perfect safety and with results equal to those obtainable with first-class sand. Crusher-run screenings contain too much dust and fine material to secure the best results—often 25% of such screenings passes through a 100-mesh sieve. With the ordinary proportions, concrete made from these screenings

will be weak and porous unless mixed more thoroughly than usual with sand as fine aggregate. When the water is added, there is a tendency for the fine aggregate to "ball up."

To overcome the effects of this fine material, certain things must be done. Either increase the richness of the mixture or increase the mixing time and allow the forms to remain on the concrete for additional time. Increasing the amount of cement may not correct the trouble without extra mixing.

An example of the class of concrete which can be secured when these points are taken into consideration is found in the Cline Road near Indiana Harbor, Ind. This road, built over two years ago of a 1:1½:3 mixture has proved of unusually excellent quality, although the screenings used contained considerable dust. Good results are no doubt in part due to the use of coarse aggregate ranging in size from 2 in. down to ¼ in.

W. M. KINNEY.
Chicago, Ill. Universal Portland Cement Co.

Wants Better Attention to Repair Part Orders

Sir—A situation has recently been brought to my attention which I believe would be worthy of space in your publication, and might possibly stir up something for the betterment of both contractors and manufacturers, in these days when we are hearing so much about efficiency.

I have had occasion in the last month to write three different factories for repair parts, one a pump company, one a gas engine company and one a manufacturer of jacks. With each of these orders it has taken two or three weeks to get even so far as making them understand what I want.

The first manufacturer sent a part that it was almost impossible to have broken and that any one should have known was not what I described. This I returned and sent a sketch showing what I wanted. In a few days I got a reply from the district office saying the order had been turned over to them, and if I would take the matter up with them, they would take it back to the factory and have them ship the part. This was done, and after two weeks' waiting since I took the case up with the district office I have not even heard further from the order.

In the second case I wrote requesting immediate shipment of parts and giving the number and horsepower of the engine. After about 10 days I got a request for the number of the engine before they could ship the parts, in spite of the fact that I had given this on the original order.

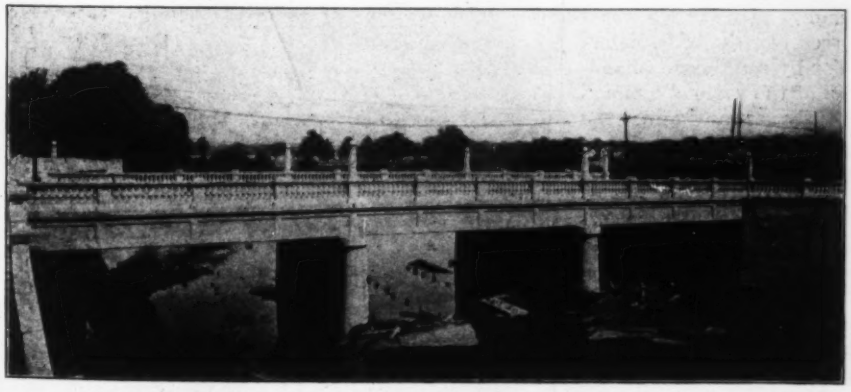
In the third case I wrote describing the part and giving a sketch with dimensions of what I wanted. The part sent was nothing like the part needed. Now, to a man out on a job often in need of parts in a hurry and not having all the information that might be kept in an office these little things mean a lot. The inconvenience and delay costs more than the parts, and such treatment is not likely to induce purchasing of more equipment from the same firm.

I am not taking this up from any other standpoint than one of coöperation, and no doubt there are cases in which I might have been more careful in ordering: but in those mentioned I was as explicit as could be. I try to keep part catalogs, when they can be obtained from the manufacturers of the equipment I have, and to anticipate replacements, but there certainly are times when a little intelligence on the part of the sales or shipping departments would greatly help working conditions all around. L. W. SHIPMAN,

Shipman, Lincoln & Welch, General Contractors.
Phillipsburg, Penn.

Army Sanitary Corps Created

A sanitary corps under the Medical Department of the Army has been provided for in an order of the War Department recently approved by Secretary Baker. The corps will include experts in sanitation, bacteriology and sanitary engineering, and men skilled in the work of supply, transportation and storage required in connection with the work of the Medical Department of the Army. Officers of the corps will be provided by assigning officers of the Medical Reserve Corps or by the appointment of citizens of the United States found under regulations established by the Secretary of War to possess the necessary knowledge. There will be no grade in the Sanitary Corps above that of major. The number of officers in the corps may be about equal to but not exceed one for every thousand of the total strength of the military forces authorized from time to time by law.



White Tile Decorates Concrete Bridge

In Hamilton County, Ohio, rather artistic effects are being attained in reinforced-concrete girder bridges by the use of ornamental white tile. In this bridge the structure is of concrete, with the usual gray concrete tone, but the railing and lamp posts are of white tile. W. H. Boeh, of Cincinnati, is county engineer.

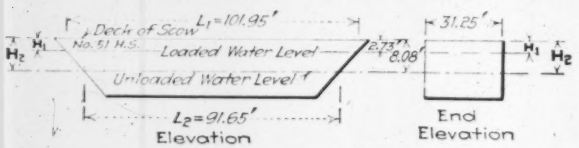
THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

Measure Riprap Yardage on Scows by Average Voids and Displacement

By J. H. Sawkins
Jersey City, N. J.

IF IN determining the yardage of rock that is delivered on scows, the average percentage of voids of the particular class of rock is used in connection with a displacement measurement of the loaded scow, a much better and fairer method is established than by taking



DISPLACEMENT MEASUREMENT OF SCOW NUMBER 51 H.S.

L_1	L_2	H_1	H_2	Remarks	
101 70	91 60	2 58	7 88	Density Salt Water	1 024
102 20	91 70	2 15	7 85	Density Syenite	2 8
		2 94	8 19		
		3 23	8 41		
101 95	91 65	2 73	8 08	Averages	

V_1 = Vol. Salt Water Displaced = (101 95 + 91 65) ÷ 2 × 5 35 × 31 25 = 16183 8 cu.ft.
V_2 = Equivalent Vol. Fresh Water Displaced = 16183 8 × 1 024 = 16571 2 cu.ft.
2 8 : 1 0 :: 16571 2 : V
V_3 = Vol. Solid Stone = 5918 3 cu.ft.
V_4 = Vol. Stone by "Average End Method" = 11763 5 cu.ft.
Voids = 5845 2 cu.ft. Percentage Voids = 50 3%
"Percentage Factor" = 11763 5 ÷ 5918 3 = 1 99

QUICKER AND MORE ACCURATE THAN CROSS-SECTIONING

cross-sections of the pile and calculating the cubical content by the "average end area" method. This last is very rough, especially when the individual pieces of stone vary from 2 to 6 tons apiece, rendering it very difficult, if not impossible, to cross-section the pile with any reasonable degree of accuracy.

The average percentage of voids being practically a constant figure for any particular grade of rock, it is only necessary to obtain the displacement of the loaded scows as they are delivered on the work, correcting for any list that the scow may have when loaded and for the amount of water that may be in the hull. However, if measurements are taken from the deck to the top of the water at the four corners of the scow, most of these errors, as well as that due to the roughness of the water, are reduced to a minimum.

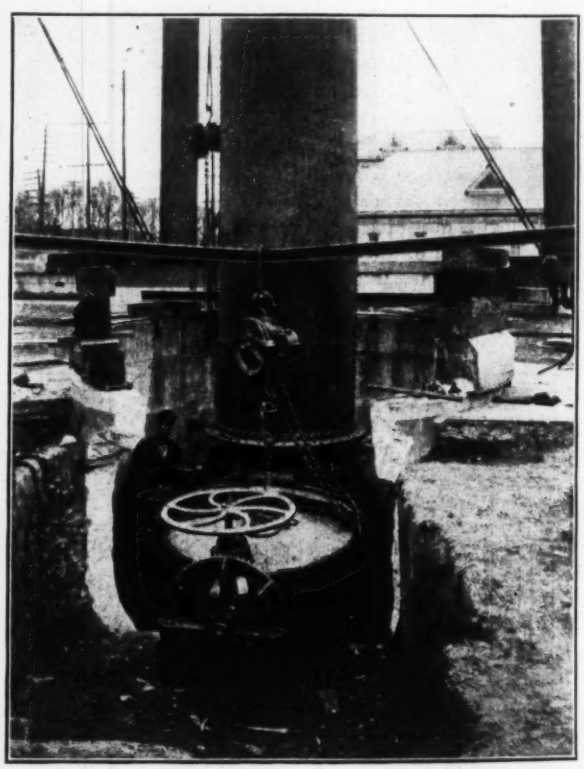
The specific gravity of the rock can easily be determined by rough measurements or by reference to handbooks giving the specific gravity of the various common kinds of rock. It will be sufficiently accurate to use the figure 1.024 for the density of salt water and to measure by cross-sectioning the yardage of about 25 scows before adopting a final figure for the percentage factor. As an instance of the accuracy of this method, on a certain job the stone on 50 scows was cross-sectioned, and it was found that the factor calculated from the measurements of the first 25 scows differed only about 0.01 from that for the remaining 25.

This method was used successfully to measure the yardage placed for the construction of a bulkhead and dock for the Mexican Petroleum Co., at Carteret, N. J., for which work Henry Speers, New York City, was the contractor. On this particular work it was found that the factor for rock varying in weight from 1 to 6 tons, with a specific gravity of 2.8, was 2; that is, the percentage of voids was 50%. Only a little experience with this method will convince anyone of its value.

48-In. Valve Connection Placed on a 52-In. Tank-Riser Pipe

THE very large elevated water tank at the filtration plant of the Louisville Water Co., Louisville, Ky., was originally installed without a valve between the 48-in. water-main connection and the 52-in. riser pipe. The steel riser pipe recently commenced to show signs of deterioration, and it was decided to put in a valve at the base so that the riser could be cut out for repairs without interference with the connecting mains.

The method of procedure was as follows: The expansion-joint connection at the cylindrical bottom of the tank was fixed so that there would be no movement. This was done by taking out every other bolt in the flange connection and inserting plates of steel which would completely prevent the riser pipe from moving.



PLACING 48-INCH VALVE IN WATER-TANK RISER PIPE

Four ¾-in. steel cables were then attached to the tops of the four steel tower legs and extended down about two-thirds the length of the riser pipe to which they were fastened. In the middle of each cable was a steamboat ratchet or turnbuckle which permitted each cable to be given the proper tension. The weight of the riser pipe was thus carried by the framework of the tower.

Below the last riveted joint in the riser pipe a length was measured which, allowing for a new row of rivets, would just equal the height of the valve to be inserted. An oxyacetylene torch was then used to cut off the riser pipe at this point. The section of pipe to be removed was taken out, and the shortened bottom length of 52-in. pipe was raised a few inches inside the section above by chain hoists, as shown in the accompanying view.

The valve was then moved into place and the bottom section of the riser pipe lowered upon it. Holes were drilled in the new bottom section of the riser pipe for the rivet and the connection completed. James B. Wilson is superintendent and chief engineer of the Louisville Water Co., under whose direction the work was done.

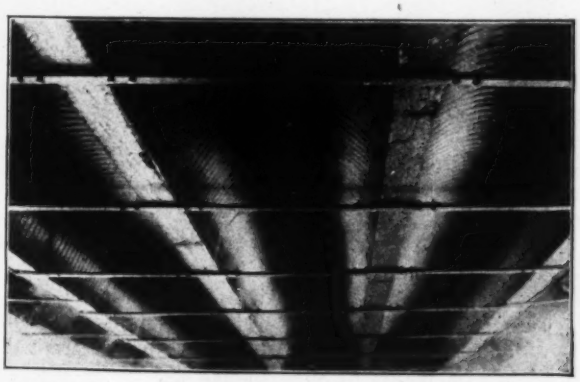
Set Slope Stakes a Foot Outside

By L. M. Mitchell
Assistant Engineer, Minneapolis & St. Louis Railway, Oskaloosa, Iowa

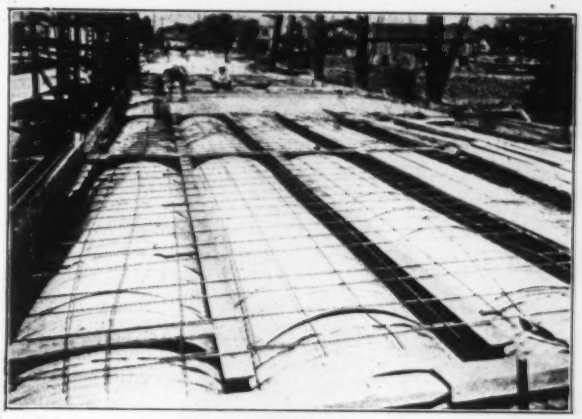
A DEVIATION from the usual manner of setting slope stakes for railroad grading has been used successfully by the writer. Instead of the stake being driven slanting at the toe of the embankment or top of the cut, it is moved out one foot farther and driven down straight. Thus, each center-line stake is practically referenced by two hubs, which are much less likely to be displaced than if set at the edge of the slope. If the contractor is advised of the method of setting the stakes, it has proved easy and convenient for him to make his measurements accordingly.

Culvert Pipe Used as Basis for Floor System to Bridges

A REVERSION to an old system of highway bridge floor, with some modern variations, is seen in the use of corrugated iron culvert pipe forming the basis for concrete arch floor spans. In the old designs light



UNDERSIDE OF COLORADO BRIDGE FLOOR WHERE CULVERT HALF ROUNDS ARE USED AS FORMS



CONCRETE FLOOR OF OHIO BRIDGE TO BE PLACED ON CULVERT SECTIONS AS FORMS

gage corrugated steel in the new type half sections of heavy-gage culvert iron is used, with additional reinforcement of the concrete floor against expansion.

One view shows such a floor as installed on a through-truss bridge in Hamilton County, Ohio. For this bridge the culvert forms span between the bottom flanges of I-beam stringers which are framed into floor-beams. The other view shows the under side of the floor of a deck-girder bridge at Boulder, Colo. Here the main girders, 41-ft. span, are of reinforced concrete and the floor, a concrete slab reinforced against expansion with ¾-in. rounds on 10-in. centers in both directions, is coured on half-culvert sections spanning steel 24-in. I-beams which are spaced 4 ft. apart and placed parallel to the main girders and span between the abutments. In this bridge the I-beam stringers are stiffened by cross-braces of steel bars, as shown.

Cleaning Water-Settling Basins at Grand Rapids

By Walter A. Sperry
Chemist, Water-Filtration Plant, Grand Rapids, Mich.

A CHANGE in the method of cleaning the settling basins of the water-purification plant at Grand Rapids, Mich., has materially lessened the amount of labor required and made it less hard and unpleasant. The change was simple and like all simple arangements has worked wonderfully well.

Our two basins together are approximately 100 x 200 ft. in plan, divided into 14 parallel bays by "round-the-end" baffle walls spaced about 15 ft. apart. At the lower end of each pair of bays is a small pump connecting to the general drain for all the basins leading back to the river. Along the opposite or back end of these same bays there runs a 6-in. city pressure main and also a 16-in. line connecting with the chamber receiving the raw water from the pumps. On the pressure main and the raw-water main are valves and gates, respectively, supplying flushing water for each pair of bays.

These basins are some 12 ft. deep. Under ordinary conditions from 8 to 10 ft. of sludge collected over half to one-third the area of these basins every one to one and one-half to two months, according to the time of the year.

The removal of this sludge was a large problem, especially in the winter time. It required four or five men working all day in rubber suits, many times standing in water and sludge up to the hips, and it required a long day for the cleaning of each of the two basins. It was a job to be dreaded. It was hard on the men even under summer conditions, and required a great deal of hose that rapidly deteriorated by being dragged back and forth over the rough concrete floors of the basins.

By way of remedy, 2½-in. pipe was laid the full length of each bay, drilled with ½-in. holes on the horizontal diameter, spaced 2 ft. apart and staggered so that there would be a jet of water for every foot of pipe on opposite sides. This was connected behind the valve on the city pressure line so that either or both could be used and so that the pressure could be turned onto the piping system from the lawn above.

The basin which is to be cleaned is cut out, the pressure turned on for a half hour or so, and then the drains are opened and the whole allowed to work—usually overnight. It is then only necessary for two men to work perhaps one or two hours, and sometimes not that long, with a hose from the top to clean up some of the worst of the corners.

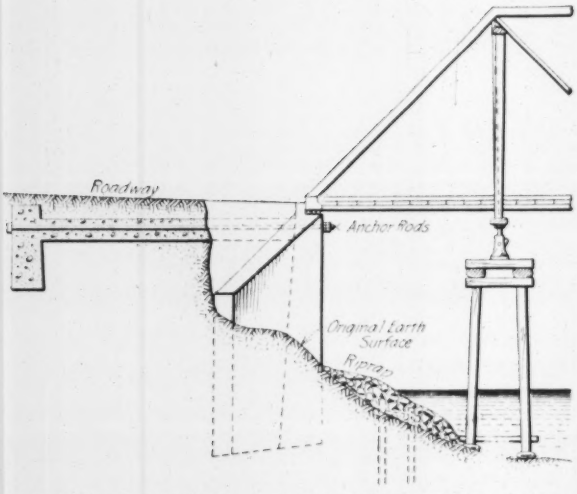
The cleaning is not as thorough as when done by going into the basins with the hose lines but it is good enough, and it works equally well under both summer and winter conditions.

Slipping Bridge Abutment Saved

By R. T. Brown

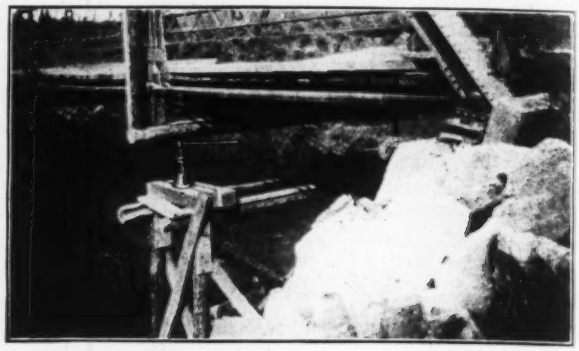
Highway Engineer, Davidson County, Lexington, N. C.

A CASUAL inspection of the 100-ft. steel highway bridge which was built some time ago without engineering supervision showed that the anchor bolts were bent and the shoes were pressed tightly against them. There was no information available as to the exact location of the abutment or as to the batter of the faces, but it was very easily seen that one of the abutments had moved. An investigation indicated that while one abutment rested on hardpan or rock, the other—which is about 18 ft. high above water level and of unknown depth below—probably rests on a fine sandy loam. The stream channel shifting has eroded this deeply.



ABUTMENT RETAINED BY CONCRETE-INCASED RODS PASSING THROUGH CONCRETE DEADMEN

To prevent further erosion, two lines of piles were driven near the toe of the slope and the whole slope



BRIDGE RAISED BY JACKS PLACED UNDER FIRST PANEL POINT

covered with a heavy riprap of stone. Holes were drilled through the abutment near the juncture of the wings and face, and 1¼-in. rods, 34 ft. long, were placed in trenches running back along the roadway. These rods were incased in concrete for their entire length and anchored to concrete deadmen at the end.

To further strengthen the abutment, a narrow trench was dug along its back and filled with concrete—the extra width providing sufficient breadth to receive the bearing when it was replaced in its proper position.

When the concrete at this point was hardened sufficiently, the nuts were tightened on the tie-rods, a new anchor bolt hole drilled and the bolt grouted in. To lift the bridge while widening the seat beams, struts made of pine logs flattened on two sides were attached at the first panel points, as is indicated in the line drawings. A beam rested on top of these struts and passed under the top chord. The bottom chords, stiffened by means of 4 x 6 timbers inserted between the floor-beams, completed the provisions against reversed stresses. While an attempt was made, contrary to instructions, to lift the bridge before the stiffeners had been placed, which resulted in the I-bars buckling slightly, no accident occurred during the repair, and traffic was maintained over the bridge during the job.

New Wireless Station in Alaska

A permanent wireless station at the City of Anchorage, to replace the present temporary plant, is being erected by the Alaskan Engineering Commission. It is located on Government Hill, and involves the erection of two 200-ft. fir masts, carrying a six-wire aërial with a spread of 30 x 400 ft. The building will contain an operating room, generating room and living quarters for two men. A 2-kw. 500-cycle transmitting apparatus and one of the latest types of receiver with supersensitive audion detectors and amplifiers will be included in the operating equipment. For the present power will be obtained from the alternating plant in the terminal yards. The apparatus now in use has an operating radius toward the sea of about 500 miles.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Home-Made Unloaders Save Time on California Road Work

THE time required for loading motor trucks with sand or gravel shipped in gondola cars has been cut down on road work in California by a home-made device used like the car unloaders now on the market, and termed a loading box. The boxes are used as temporary receptacles into which the material is shoveled from the car while the trucks are going to and from the job. Two or more loading boxes are set on the edge of each car, two having a capacity sufficient to load a 3½-cu.yd. truck. When the truck is in position the contents of the two boxes can be dumped into it in four or five minutes.

The boxes are made up of 2-in. plank strengthened at corners with strap iron and provided with a door at one end which can be opened when the box is dumped. By means of a long lever, a 4 x 4 which extends entirely across the car and rests on the opposite side, it is easy to tilt the boxes for dumping although the center of gravity is far enough inside of the car edge to give the box stability while the men are shoveling into it. The sides of the boxes converge slightly toward the end in which door is placed, so that the material flows out freely when tilted to dumping position.

By varying the number of boxes and shovelers according to the truck haul and number of trucks employed, it is possible to keep motor truck delay at the point of loading down to a minimum. When the car sides are lower than the height required to dump by gravity into the truck, a false side is built up to the desired height by a simple timber frame and the loading boxes are rested on this as they would be on the side of the car were it of suitable height.

The scheme has been developed and is being used by the California Highway Commission of which A. B. Fletcher is chief engineer.

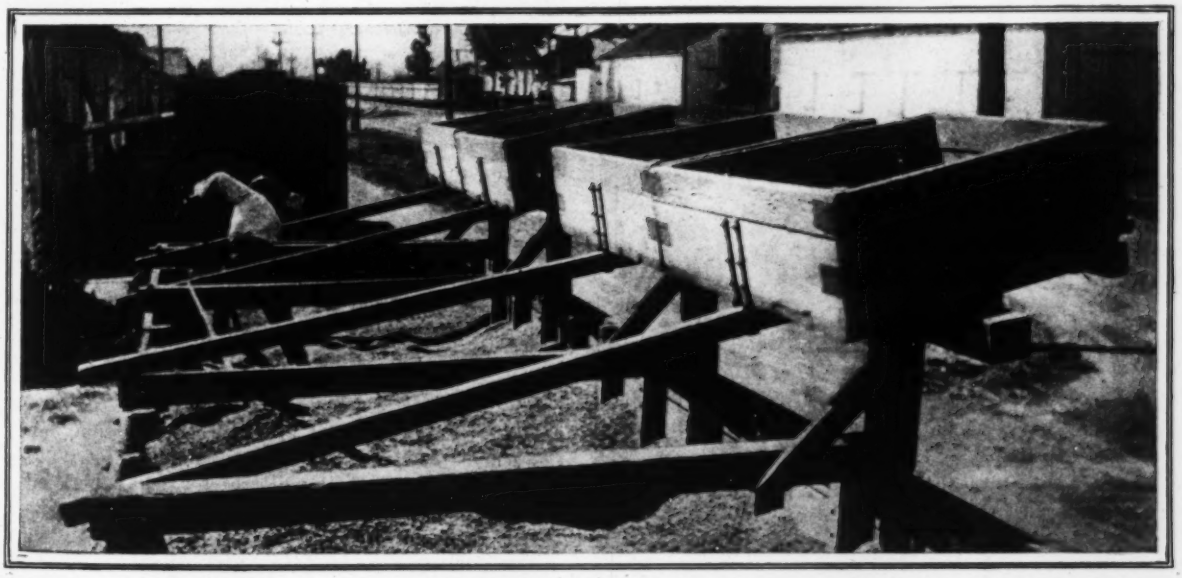
Sledge Hammer Used To Break Down Arch of Old Brick Sewer

A SLEDGE HAMMER was found to be the best thing to use to break down the arch of an old 11-ft. circular brick sewer, which is being rebuilt for a length of several hundred feet in Cincinnati, by P. Foley, contractor.

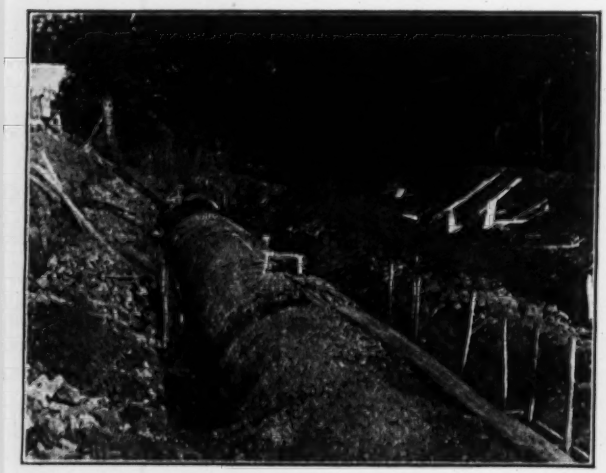
The job consisted of knocking off the arch of the sewer from the springing line up, and building vertical walls and a slab roof of reinforced concrete. The concrete is also carried down the outside of the invert a distance of 2 ft. for strengthening purposes.

After figuring on the use of air hammers and other methods, the contractor concluded that the use of sledge hammers would be cheapest and best for breaking down the arch. He uses his men for this work when they have nothing else to do. A man at 30c. an hour can break down 10 ft. of arch in a day of eight hours. The contractor builds a plank platform through the old sewer at the level of the springing line. The débris falls onto this platform and is then shoveled out. He dug his trench wide enough so that he could throw the débris outside without interfering with the new construction work.

The old sewer passes beneath the Miami and Erie Canal, built in 1847. On breaking into the embankment



HOME-MADE UNLOADERS ON CALIFORNIA ROAD WORK MOUNTED ON LOW-SIDED GONDOLA



WIDE TRENCH MADE ROOM FOR DEBRIS FROM SEWER ARCH

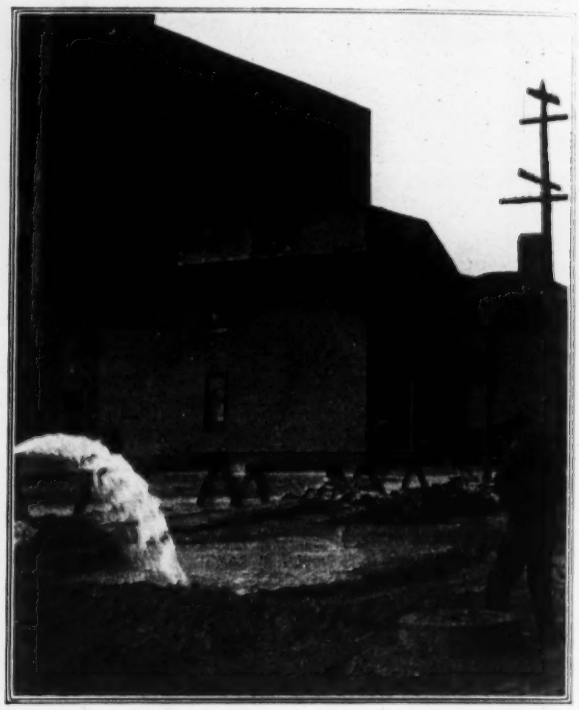
of this canal the contractor found that the sewer was laid inside of an old stone culvert, with a 3-ft. ring laid in lime mortar. This he had to remove in order to enlarge the upper part of the old sewer. The resistence of the old culvert was not known when the contract for this work was let. It remains to be seen whether the city will allow him extra for taking out the old culvert.

Find Untamped Holes in Street Subgrade by Ponding

HIDDEN holes in a street about to be paved are located in Cleveland by ponding, which will disclose any untamped areas by washing dirt down into the cavity.

When the grading of a street is practically complete puddle dams are built and filled to a depth of at least 12 in. The length of time that water should stay in the pond varies considerably with the different kinds of soil. In coarse sand or gravel it will normally run o in less than a day, and in some kinds of clay it w evaporate instead of running out. In the latter ca the water is let out after about 48 hours. The hol do not always show up as the one in the picture ha but their presence may be known by the rapidity wit which the water runs out. Careful use of this metho

PLACE WHERE WATER FOUND A CAVITY



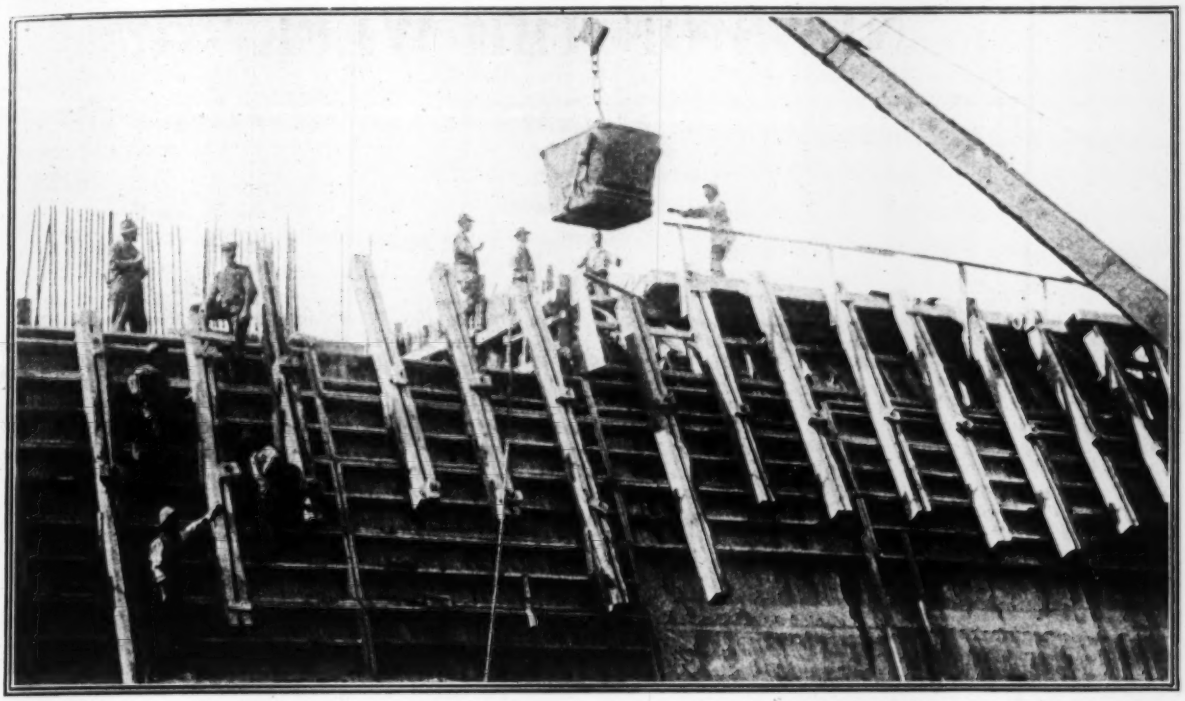
PUDDLE DAMS FILLED FROM HYDRANTS

even in the hands of an inexperienced man will, it is claimed by those who have tried it, disclose most of the holes, while nearly all may be discovered in a minimum of time by one whose experience with the different soils gives him something on which to base his judgment.

Sliding Cantilevered Studding in Forms for Canadian Dam

CANTILEVERED vertical studding which does not have to be taken down to set the next lift of forms is used to support the forms for La Loutre dam, being built on the upper St. Maurice River by the St. Maurice Construction Co., for the Quebec Streams Commission. By the use of such supports the interior spaces where concrete is being deposited are kept clear of all tie rods. Two pieces of timber on edge are held parallel and 1 in. apart, being double bolted through a space block at the upper end. This arrangement gives a slot the whole length of the support, so that it can be slid vertically upward for another lift of concrete. In this respect the scheme differs from previous forms of same type, a good example of which were those used at the Welland Ship Canal, and described on page 511 of the *Engineering Record* for Oct. 21, 1916.

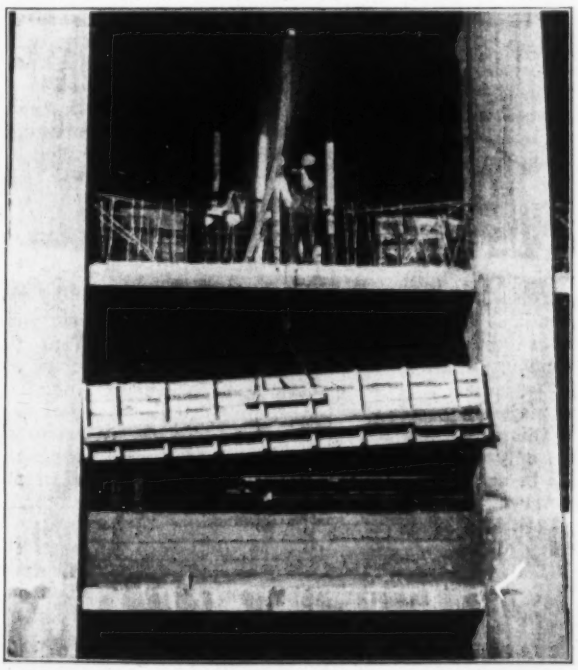
The holding bolts are tightened when the form and support are in place for proper alignment. If there is any overhanging, the heel or lower end of the support



CANTILEVER SUPPORTS SLIDE UP ON BOLTS WHEN FORMS ARE RESET

is blocked outward. Form framing here is horizontal and lagging is vertical.

Holding bolts 1 in. in diameter are spaced at 2-ft. intervals. The bolts are wrapped in a sleeve made of paper which has been dipped in tar and dried. At the inner end is a 3 x 3 x $\frac{5}{16}$-in. plate. Very little difficulty has been found in screwing the bolts out. Large square washers at the end span both timbers of the support.



LIGHT-WHEELED DERRICK RAISES CURTAIN-WALL FORMS

Build Curtain Walls with Simple Forms After Concreting Floors

By J. G. Grossman
Superintendent, Peter Keeler Building Co., Fort Edward, N. Y.

On concrete building work, where it is not necessary to pour the curtain walls monolithic with the columns and slabs, the writer has found it economical to start at the bottom and carry work up with one set of forms, raising the slabs outside the building with a small derrick as shown in the photograph. This derrick was mounted on a small four-wheeled platform and needed no guys. However, a strut from the back part of the platform to the floor slab above was usually placed to insure its stability. A two-part fall of $\frac{3}{4}$-in. wire rope was used, the derrick being operated by a crab.

The inside and outside slabs of the curtain wall forms were held together at the bottom by bolts, while a ladder yoke such as was described by the writer in the *Engineering News-Record* for July 5, 1917, page 41, secured the forms at the top.

One Week Only from Tree to Roof-Tree

An indication of the speed with which materials are being moved is contained in a report from the cantonment at Louisville, Ky. Administration buildings there were built from lumber cut in a Mississippi pine forest the week before. The trees were felled on Saturday, kiln-dried on Sunday, loaded on freight cars on Monday, and delivered at the Louisville site on Wednesday morning. An army of energetic carpenters completed the transformation from forest to Government building just one week from the day the trees had been felled. This is probably a record in work of this extent.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELD

Sticks to Brick for Sewers

Against Advice of Engineers—Detroit Council Refuses to Open Sewer Specifications

About to enter upon the first half of $16,000,000 of sewer construction, the city engineer of Detroit, with the approval of the engineer-commissioner of public works, attempted to open the local specifications to other material than brick, but has been balked by the Common Council, as stated in *The Public's Business*, issued by the Detroit Bureau of Municipal Research, under the heading:

FACTS CONCERNING COMPETITION IN SEWER CONSTRUCTION:

"Brick has been used in Detroit sewers for the past 60 years, and the present specifications require that brick only be used in sewers of over 30 in. diameter.

"The largest sewer contractors of Detroit are said to be interested in local brick manufacture.

"Reorganization of sewer methods began Dec. 29, 1916, when Clarence W. Hubbell, an engineer of recognized competency, was appointed city engineer.

"Revision of specifications covering sewer construction was undertaken Jan. 15, 1917. It was desired to include several types of construction—brick, segment block, reinforced concrete, monolithic concrete, etc.—in order that there might be real competition.

"Eight million dollars was authorized for sewer construction by the Board of Estimates and the Common Council on May 1. This sum is part of a $16,000,000 program, and is more than the present sewer system has cost to date.

"To feel out sentiment on the use of other material than brick, contracts for the Evans Ave. were submitted to Council on June 6. The bids were $30,133 and $29,779 for brick and $25,771 for segment block. The city engineer recommended accepting the lowest bid, which meant a saving of $4008, or 14%, on this small job.

"A favorable attitude on the Evans Ave. sewer was taken by the Sewer Committee. Later, the corporation counsel ruled that segment block could not be bid upon under the present specifications.

"Anticipating the revised specifications, the Sewer Committee took a junket beginning July 31. They visited Cleveland, Akron, Columbus and Cincinnati, where they found 'wide-open' specifications, active competition and segment block and concrete in successful use.

Divided Opinion As to Canada's Railway Situation

Opinion is divided in Canada as to the desirability of the Government taking over the Canadian Northern Ry., in accordance with the plan announced in these columns Aug. 9, p. 285, at the same time advancing $7,500,000 to the Grand Trunk Pacific Ry. to help it through its immediate difficulties. The Toronto *Monetary Times*, which favors the minority report of A. H. Smith, of the Royal Commission, argues that the scheme now proposed, while failing to solve the main problem, would effectually block progress on it for some time to come.

Force Account Road Contracts Held Legal in Oregon

The attorney general of the State of Oregon recently held that it would be legal for the State Highway Commission to award highway contracts by force account. Recently the commission rejected all bids for a road contract in eastern Oregon and desired to let the contract to the Wafren Construction Co., of Portland, by force account, the company to furnish all materials, equipment and help, and to be paid a certain percentage of the cost as profit.

Testing Ten Makes of Water Meters

Ten different makes of water meters are being tested by Reeves J. Newsom, superintendent of water-works, Lynn, Mass., preparatory to buying 7000 meters in order to meter the remaining half of the consumers. It is reported that a part of the program is to let all the meters freeze when cold enough weather comes and then compare results upon their anatomy and physiology.

"Revised specifications were submitted to Council Aug. 14 and referred to the Sewer Committee, which now has them under consideration.

"The next move is up to the Common Council. In the meantime, we wanted you to know the facts."

Excuses given by the majority members of the Council for this action are that they wish to have only material of approved merit used in sewer construction; and that "in every city where we found the segment block in use, we also found an intertwining of interests between the city officials and segment block makers."

The reason for opening the specifications, to quote again from *The Public's Business*, is to get "competing contractors with competing materials."

Study Modern Maintenance Methods for Roads

Bulletin Bearing on This Subject Being Prepared by Office of Public Roads

For some years it has been the hope of the Office of Public Roads that a careful study of the latest methods of highway maintenance could be made and by the preparation of a carefully constructed bulletin bearing on this subject that maintenance methods throughout the United States could be more or less standardized. This idea originated with E. W. James, inspector for the Eastern district, and was recently put into active force by the assignment of the undersigned to assist Mr. James in making the proposed study and preparing the subject matter for the bulletin. The work is being done under the direction of J. E. Pennybacker, chief of economics.

The present purpose is to visit all state highway departments where maintenance methods have been highly developed and to make a thorough study of the systems of organization which have been developed and the actual field methods in use in caring for the various types of pavement. Cost accounting systems, records, etc., are also being studied and it is hoped that from the data collected definite recommendations as to these matters can be made.

An effort is also being made to permit the manufacturers of important road materials to make suggestions as to their proper maintenance, but it will, naturally, be impossible to call on everyone who may be interested in this matter, and it is suggested that any who desire to insure consideration of their views correspond with Mr. Pennybacker.—*G. L. Harrison.*

Goethals Engineer for New York Port Commission

The two commissions appointed by Governor Edge, of New Jersey, and Governor Whitman, of New York, to investigate conditions at the Port of New York were organized Aug. 22. Gen. George W. Goethals was appointed chief consulting engineer. The work of the joint commission will pertain to all matters affecting the development of the Port of New York, with all territory contiguous to the port. It is stated that the railroads will be consulted about terminal plans, etc., as will storage warehouse and steamship companies. The commissions will report to the legislatures of their respective states. The offices of the joint board are at 115 Broadway, New York City.

Will Spend $8,500,000 for Port Improvements

Chile Asks American Contractors for Bids on Harbor Works To Hold Nitrate Business

The Government of Chile will expend $8,500,000 in the improvement of Antofagasta, the principal port for the export of sodium nitrate. Chile's nitrate business has grown greatly because of the war's cutting off the German supply from other nations and also because the manufacture of munitions has increased the demand for saltpetre. One of the objects of Antofagasta improvement is to equip Chile to hold this greater nitrate business after the war is over.

The Chilean Government has turned to the United States to have this work done and bids have been asked of American contractors for the construction of the waterfront improvements, as well as bids for taking up the loan the Government will make to finance the undertaking.

A request for bids prepared by the Chilean Embassy says:

"The Government of Chile asks public bids for the contract of the foundation work for the improvement of the port of Antofagasta, at a price not above £1,700,000."

Referring to the financing of the project, the advertisement says:

"The parties interested in these bids can also present with the proposal for the construction of the port works another bid to take charge of the loan of £1,700,000, authorized by law No. 3132, on Sept. 4, 1916, the proceeds of which will be invested in the payment of the works above mentioned. The bonds of this loan will earn 6% interest and they will have an accumulative amortization of 2 per cent.

"The payments can be made in installments according to arrangements during the progress of the work. The proposal for the placement of the loan will be only accepted jointly with the one of construction, but this latter may be accepted independently of the former one. The Government reserves, notwithstanding, the right of contracting the loan separate from the contract of construction. In equal condition it will favor that proposal offering also the placement of the loan."

All particulars may be obtained from the Chilean Embassy in Washington or from the consulate general of Chile in New York.

Los Angeles Building Concrete Road for Motor Trucks

A special road for motor trucks is under construction in California. It runs from Los Angeles to the harbor at San Pedro, a distance of 13 miles, and has a width of 40 ft. The road foundation is of water-bound macadam upon which is placed solid concrete to a depth of 8 in., with a bituminous top surface. It is estimated that the road will cost $365,106.

St. Louis' Garbage Problem Further Complicated

Recent Proposal of Chicago Chemist May Reduce Initial as Well as Operating Cost

The garbage situation in St. Louis has been further complicated by the proposal of Dr. J. M. Hirsh, a Chicago chemist. Dr. Hirsh appeared before the Board of Aldermen, and also before the Board of Public Service, presenting a new scheme for the reduction of garbage by steaming in the presence of certain chemicals, the nature of which was not revealed. He claimed to be able to produce completely desiccated and odorless solid matter and a liquid very high in valuable grease and capable of further reduction at a low cost. He further claimed that the necessary plant for this work could be built for about $200,000 as compared with $680,000 for the Cobwell plant. Dr. Hirsh was permitted to make a demonstration on a small scale, which showed very satisfactory results.

Another ordinance was introduced providing for the construction of an experimental plant for the Hirsh system at a cost of about $17,000, Dr. Hirsh to give bond to refund this amount if unable to produce satisfactory results. Both this ordinance and the ordinance for the Cobwell system plant are still pending.

New Haven Starts New England's Largest Freight Yard

Work has been started by the New York, New Haven & Hartford R.R. at Montowese, near New Haven, Conn., on what is to be the largest railroad freight yard in New England. Its purpose is to meet the needs of a traffic that has outgrown the numerous smaller yards on the company's various lines radiating from New Haven. Trains from all of these lines will be classified for all destinations at the new yard.

Details of the design are not yet available. It is, however, to be a hump yard, and there are to be two main sections, one for eastbound and northbound, the other for westbound and southbound traffic. Each section will in turn have three units—receiving, classification and departure. The eastbound and northbound classification unit will contain 25 tracks; the other classification unit 15 tracks.

Other features include a 16-stall engine house and a large transfer station on the platforms of which motor trucks and trailers will be used. There will also be a complete separation of grades at Air Line Junction.

No City Manager for Bridgeport

The proposed commission-manager charter for Bridgeport, Conn., noted on page 234 of our issue of Aug. 2, 1917, was defeated on Aug. 11 by a vote of 2898 to 931, with 650 ballots given out but wasted. Only one-fifth of the registered voters went to the polls.

Extraordinary Improvement in Car Supply

Railroads' War Board Reduces Shortage by 75 Per Cent. 30,000 Cars for Cantonment Work

Reports received by the Railroads' War Board show that the railroads of the country, in their coöperative efforts to give to the country the greatest possible amount of freight service, have effected an extraordinary improvement in freight car supply.

These reports show that the excess of unfilled car requisitions over idle cars, or what is ordinarily but inaccurately termed car shortage, was only one-fourth as great on Aug. 1, 1917, as on May 1, 1917.

Car Shortage Reduced

The excess of unfilled car requisitions on May 1 was 148,627; on June 1 it was 106,649; on July 1 it was 77,682; and on Aug. 1 it had been reduced to 33,776.

This result has been accomplished at a time when the railroads are supplying from 15 to 20% more freight service with the same number of cars than was being given this time last year, for the railroads handled in July a tremendous increase in both Government and commercial traffic.

The movement of cantonment supplies alone occupied the full services of more than 30,000 cars. There was also an extraordinarily heavy demand for cars to transport food products, as well as materials to and from munition factories.

Result of Coöperation

The result above achieved has been accomplished by coöperation with the railroads of shippers, regulating bodies and the public generally. This coöperation has made possible the intensive loading of freight cars, prompter unloading, the eliminating of a large amount of unnecessary passenger train service and an opportunity generally to utilize the railroad plant efficiently.

The aim of the railroads at the present time is to put each car to the greatest possible use, to have empty cars placed where they are most needed, to prevent overlapping and unnecessary service—in other words, to make the entire railroad system of the United States the most effective possible transportation agency in winning this war.

Savannah Will Annul Contract for Kayton Canal

Steps were taken by Savannah, Ga., to annul the contract with the Carolina Construction Co. for the construction of the Kayton Canal, work on which has been suspended. It is proposed to have the city take over the plant and complete the canal, which is about 50% finished, according to E. R. Conant, chief engineer of the city, who has inspected the work. A report made two weeks ago indicated that the work was about 75% completed. The contract involves about $45,000.

PERSONAL NOTES

A. O. POWELL, consulting engineer, Seattle, Wash., has been commissioned major in the Engineer Officers' Reserve Corps and has been ordered to New York for assignment to duty.

A. N. EASON and A. N. GARLAND, of Seattle, have formed a contracting firm to be known as Eason & Garland, with offices in the Greene Building.

CALVIN W. HENDRICK has resigned as chief engineer of the City of Baltimore on the ground that his private affairs demand all his time. Mr. Hendrick was chief engineer of the Baltimore Sewerage Commission during the construction of the immense sewerage and sewage-disposal system from 1905 to 1916, when he became chief engineer of the city. The latter position was created with a view of having a single directing and coördinating head for all the engineering work of the city, who would also serve as technical adviser to the mayor. It is reported that the vacancy will not be filled by Mayor Preston. The position paid $7000 a year.

A. P. MCCARTON, resident engineer in charge of the raising of the Big Creek Dam at Huntington Lake, California, has received a commission as first lieutenant, Engineer Officers' Reserve Corps.

SHIRLEY BAKER, of the firm of Baker, Carpenter & Waters, San Francisco, is in charge of the Government pipe-laying contract at Palo Alto, Calif. This work involves the laying of a total of 27 miles of water pipe, chiefly wood stave.

A. B. FLETCHER, chief engineer of the California Highway Commission, has been appointed president of the State Reclamation Board by Governor Stephens. Mr. Fletcher succeeds V. S. McClatchy, retired, and his appointment becomes effective Oct. 1. It is understood that the new appointment will not affect Mr. Fletcher's position with the Highway Commission.

DR. HENRY M. PAYNE, consulting mining engineer, will remove his office from the Woolworth Building, New York City, to the Chamber of Commerce Building, Pittsburgh, Penn., where he will assume the position of assistant to the president of the Bertha and affiliated coal companies.

T. J. SKILLMAN, division engineer of the Monongahela Division of the Pennsylvania R.R. at Pittsburgh, has been appointed division engineer, office of the principal assistant engineer, New Jersey Division, with headquarters at New York City; and W. M. GREENE, division engineer of the Delaware Division at Wilmington, Del., has been appointed division engineer, to succeed Mr. Skillman.

H. W. MCALEENAN, formerly assistant construction engineer of the Illinois Traction System, with headquarters at Peoria, Ill., is now with the Minnesota Utility Co., in the capacity of construction engineer, with headquarters at Chisolm, Minesota.

HERBERT CANTWELL, formerly construction engineer with T. L. TOMLINES, paper mill engineer, Watertown, N. Y., is at present engaged as construction engineer for the Fargo Engineering Co., Jackson, Michigan.

TOLLEF B. MONNICHE, engineer of docks, Panama Canal, has resigned and expects to take a six months' vacation in El Boquete, Republic of Panama. Mr. Monniche was in charge of the design and construction of the Christobal terminal piers, and previous to this work was the designing engineer for the Isthmian Canal Commission, in charge of the design and erection of the emergency dams on the canal.

BUSINESS NEWS

Commission to Adjust Labor Disputes in Ship Building

An agreement entered into Aug. 25 by representatives of the Navy Department, the Emergency Fleet Corporation and of the American Federation of Labor provides for the rapid and peaceable adjustment of all labor disputes in shipyards throughout the country in order that the work of ship construction in public and private yards may continue throughout the war without danger of serious interruption.

The labor chiefs and Government officials who signed the agreement, among whom are the presidents of the great international unions, believe that the strike in New York can now be speedily settled and the great strike on the Pacific Coast, which has been hourly threatened since Aug. 14, averted.

COMMISSION TO BE CREATED

The agreement calls for the immediate creation of an adjustment commission which will consist of three, four or five members, according to the nature of the problem to be solved.

The President has designated V. Everitt Macy, of New York, president of the National Civil Federation, as chairman of commission.

Samuel Gompers, president of the American Federation of Labor, will name the second member of the commission, and the Emergency Fleet Corporation will designate the third. Where Navy work is in whole or in part concerned, Assistant Secretary of the Navy F. D. Roosevelt will sit as a member of the board.

LOCAL LABOR REPRESENTED

When trouble on a large scale is threatened in private shipyards a representative of local labor and of local shipping interests will sit as members of the commission with full voting powers.

In the event of a tie, when Assistant Secretary Roosevelt's presence raises the membership to four, the deciding vote will be cast by the Secretary of War as chairman of the Council of National Defense.

Germany as an Industrial Competitor After the War

The cosmopolitan point of view that has been acquired by the German trader is emphasized in a report which has been issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce, on "German Foreign-Trade Organization." The facts in Teutonic commercial history that are presented in this volume show how thorough are the methods that have been employed for more than half a century, and how earnestly that nation is preparing to reach out into the world markets as soon as the war is ended.

The author of the report is Chauncey D. Snow, assistant chief of the Bureau of Foreign and Domestic Commerce, who was in Germany at the time that the war broke out, investigating industrial conditions in that country. He has made use of original material based upon personal contact with the organization and methods of commerce in Germany and other countries, but for the most part his purpose was to bring together in one volume material on German trade and industry which the bureau had already published in various special reports, with some new and pertinent statistics.

Copies of the publication, "Miscellaneous Series No. 57," may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., or from the district offices of the Bureau at 20c. each.

Federal Child Labor Law Effective September 1

The new Federal Child Labor law takes effect Sept. 1. Hereafter no child under 14 may be employed in any factory, mill, workshop or cannery in the United States whose products are to be shipped in interstate commerce, and no child under 16 in any mine or quarry. The working day of children 14 and 15 years of age in factories may not be longer than 8 hours and they may not be employed between 7 p.m. and 6 a.m.

Labor Situation in Northwest Lumber Industry Grows Serious

Many contracts have been placed by the United States Shipping Board for wooden ships to be constructed in the Northwest, and progress in these yards is dependent upon the lumber supply from near-by mills. Many of these mills have been shut down because of labor troubles and the situation has become so serious that, on Aug. 18 Governor Lister, of Washington, wired to President Wilson as follows:

"For some weeks there has been a most unsatisfactory condition existing in the lumber industry in the Northwest. Many of the logging camps and lumber mills are closed and thousands of men are unemployed as a result of the strike now going on. The State Council of Defense, aided by many public-spirited citizens, has endeavored to bring about an adjustment, without success. The Secretary of War, speaking for the Council of National Defense, has suggested a solution which has not been accepted. On Thursday last I presented a plan of settlement and find that it does not meet with the approval of the operators.

BUT FEW MILLS OPERATING

"It is claimed by the operators that a sufficient number of plants are running to supply Government demands. They say, however, that this demand does not exceed 7½% of the normal output of the plants. I personally feel that during this crisis we are not performing our full duty unless we also operate the mills and camps to supply the 92½% general demand.

"Every plan thus far suggested to bring about an adjustment of the differences has failed and I am telegraphing to suggest the appointment of a commission by you to make a complete investigation covering the lumber industry of the States of Washington, Idaho and Oregon; this commission to have the power to call for information relating to the cost of operation, wages paid to employees, living conditions of employees, the prices now being obtained for lumber, sales conditions in competitive territory; in fact, to cover all lines of investigation that might furnish information which would result in obtaining a proper basis in again bringing about normal conditions in this industry.

COMMISSION SUGGESTED

"If the plan suggested appeals to you, a joint Federal and state commission might be appointed with one member representing each of the States of Oregon, Idaho and Washington, the representative member from each state to be appointed by the governor of the state.

"I suggest the above plan to you only after it appears that every other possible method of bringing about a settlement of the differences has been tried and failed. Should the plan meet with your approval, may I suggest early action? If present conditions continue the situation is certain to become more grave."

Railroad War Board Again Appeals for Car Economy

Because the demand for freight cars is greater today than ever before in the history of the country, and is increasing daily, the Commission on Car Service of the Railroads' War Board has issued a second appeal asking still further coöperation from both shippers and receivers of freight.

The commission states that the ability of the railroads to move crops depends largely upon the full loading of cars and the elimination of all delay in loading and unloading them.

The movement of lumber to the cantonments and the shipping yards has monopolized the use of more than 100,000 cars and made serious inroads into the supply that under normal conditions would handle the movement of crops and food products. To offset this handicap and secure the maximum amount of service from the cars that the Nation is dependent upon for the transportation of food supplies, the following suggestions are made to shippers and receivers:

SUGGESTIONS TO SHIPPERS

Unload promptly all loaded cars received.

Load promptly all outgoing cars and release them immediately to the railroad.

Anticipate disposition of freight before its arrival.

Do not order special types of cars when ordinary types will serve.

Eliminate use of railway equipment when tonnage can be handled by motor trucks or wagon.

Load all cars to their full carrying capacity.

HOW TO LOAD CARS

The Commission on Car Service points out that there are six ways in which the loading of cars to their full carrying capacity can be achieved, and enumerates them as follows:

More careful supervision of loading.

Producers and buyers agreeing to disregard established trade units and increase the units as a war measure.

Waiving rights in regard to minimum weights under tariff and traffic regulations.

Buyers increasing their orders so as to fill the car, and producers disposing of their output on a basis of full carrying capacity of equipment furnished.

Buyers who cannot handle larger quantities clubbing together with other buyers to make full capacity cars.

Showing customers who desire, merely as a matter of convenience, smaller units than maximum how they can help the general situation by enduring inconvenience.

HEAVY TRAFFIC INDICATED

Reports from practically all parts of the country indicate that the movement of grain and food products is going to be especially heavy during the next few months. As more than 600,000 recruits for the draft army will have to be transported to the cantonments next month and as similar unusual traffic movements produced by the war are pending and threatening severe congestion, the Railroads' War Board feels that everyone should coöperate in the movement of freight.

"Keep the cars moving with a full load, and settle differences of opinion afterward!" is the war board's advice.

Fleet Corporation Places Two Orders for Ship Lumber

Orders for 16 units or ship schedules were placed with the Southern Pine Emergency Bureau during the week ending Aug. 6 by the Emergency Fleet Corporation with the coöperative assistance of the Committee on Lumber of the Council of National Defense. Four hardwood units were placed with the Hardwood Manufacturers' Emergency Bureau, recently organized in Cincinnati, Ohio, to facilitate the handling of Government orders for hardwoods.

The hardwood schedules are being gotten out at an average price of $100 per thousand feet.

Notes from

MAKERS OF PLANT AND EQUIPMENT

The Blaw-Knox Co., Pittsburgh, Penn., is the result of a recent consolidation of the Blaw Steel Construction Co. and the Knox Pressed and Welded Steel Co. Albert C. Lehman, formerly president of the Blaw company, becomes president of the Blaw-Knox Company.

The Federal Motor Truck Co. announces the election of W. C. Rowley, for some time a member of the board of directors, to vice president in charge of sales, succeeding J. F. Bowman, resigned. Mr. Rowley assumed his new duties Aug. 16.

TRADE PUBLICATIONS

A new 80-page catalog describing various types of cranes has been received from the Whiting Foundry Equipment Co., Harvey, Illinois.

The C. F. Pease Co., 213 Institute Place, Chicago, Ill., has issued a new pamphlet describing drafting-room equipment, including drawing tables, filing cases, triangles, etc.

"Some Users of Troy Trailers" is the title of a folder received from the Troy Wagon Works Co., Troy, Ohio.

Spraco pneumatic painting equipment is described in a folder issued by the Spray Engineering Co., 93 Federal St., Boston, Massachusetts.

Link-Belt "TT" class roller chains for tractors and trucks are described in Book No. 326 received from the Link-Belt Co., Chicago, Illinois.

The Ingersoll-Rand Co., 11 Broadway, New York, is sending out four new bulletins describing "Little David" pneumatic chipping, calking and scaling hammers, "Imperial" motor hoists and stationary motors, "Crown" core breaker, air receivers, pressure tanks and moisture traps.

The following subjects are covered in new publications of manufacturers:

Monitor Detector System—The New York Brass Foundry Co., 102-104 Centre St., New York.

Roller Chains for Tractors and Trucks—Link-Belt Co., Chicago.

Some Facts About Chain Drives—Link-Belt Co., Chicago.

Rock Drill, Tappet Type—Chicago Pneumatic Tool Co., Fisher Building, Chicago.

Outdoor Metering Outfits—General Electric Co., Schenectady, New York.

Internal Combustion Locomotives—The Baldwin Locomotive Works, Philadelphia.

Hoisting Machinery for Industrial Works—Shepard Electric Crane and Hoist Co., Montour Falls, New York.

Hollow Metal Windows and Fireproof Doors—Herrmann & Grace Co., 671-689 Bergen St., Brooklyn, New York.

Oxy-Acetylene Welding Apparatus—The Imperial Brass Manufacturing Co., 1200 West Harrison St., Chicago.

Wire Rope Lubrication—The Texas Company, Houston, Texas.

Sewage Ejector for Industrial Plants—Pacific Flush-Tank Co., Singer Building, New York.

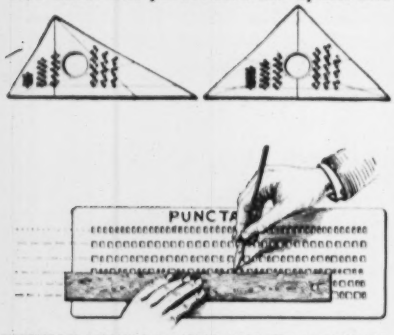
Trailers and Semi-Trailers—Watson Wagon Co., Canastota, New York.

APPLIANCES AND MATERIALS

Drawing Board Novelties Help the Draftsman and Student

An aid to drawing various broken lines is being furnished by the C. F. Pease Co., 166 West Adams St., Chicago, carrying the trade name "Punctator." It consists of a thin sheet of transparent celluloid, 4 x 11 in., with six series of openings through which evenly spaced dots and dashes may be variously drawn.

Regular-style celluloid triangles are also made but perforated for speed and

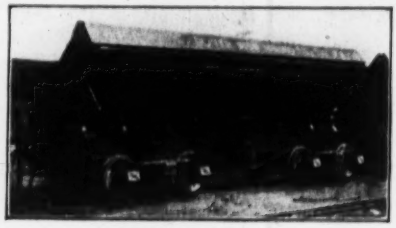


PERFORATED PLATES AND TRIANGLES HELP SECURE UNIFORM DRAFTING

uniformity in laying out guide and slope lines for lettering as shown in the accompanying sketch. Cross lines are scored on these triangles so as to obtain 15°, 30°, 45°, 60°, 75° and 90° slope lines and to square the lettering triangle with the work.

Automatic Dump Cars Are Still Further Improved

The Western Wheeled Scraper Co. has recently furnished the Oliver Mining Co., Hibbing, Minn., a large number of 20-cu.yd. automatic dump cars of the type shown in the view. These all-steel cars are so made that each one may be dumped separately and in either direction, or all may be dumped at one time from the cab of the locomotive. The air cylinders for supplying the power for dumping has a much greater clearance above the rail than former cars of same type. The cars operate very quickly and have sufficient power for dumping no matter how heavily or unevenly they may be loaded. All parts of the air-dumping apparatus are so made that they cannot be clogged with material falling from the car, nor is



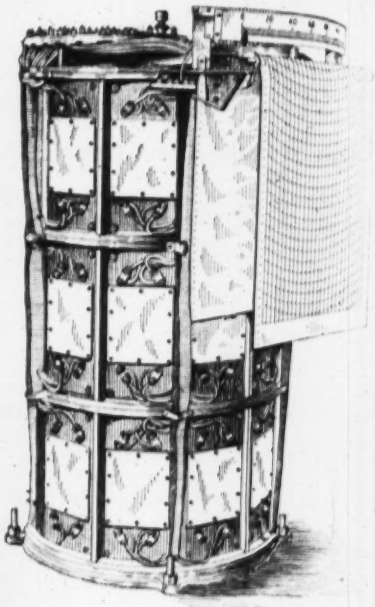
A 20-YD. AUTOMATIC DUMP CAR, WITH PROTECTED AIR DUMP

there any place where water can be held until it freezes and prevents operation. The cars are equipped with 100,000-lb. capacity M. C. B. trucks.

World's Largest Recording Meter Has 250,000-kw. Capacity

A totalizing electric power meter has recently been built by the Esterline Co., of Indianapolis, of a capacity to show the combined output of the 30 generators in the Keokuk station of the Mississippi River Power Co. The specifications, as shown by the Stone & Webster Management Corporation (the administrators of this plant) called for high degree of accuracy; freedom from appreciable errors of varying voltage, frequency, power factor and temperature; and sufficient damping to prevent overshooting.

The construction is shown in the accompanying sketch. The instrument frame is in three vertical sections and has 30 panels in each of which is the stationary element of a polyphase induction meter. Each of these unit meters in turn comprises two single-phase elements. Each tier of meter stators reacts on a common pair of horizontal aluminum rotor vanes, all six being mounted on one staff to which is connected the indicating pointer and recording pen. The charts used are printed in 12-hour lengths and are fed at 3 in. per hour over two rollers—one of which carries driving pins and is rotated by a solenoid-operated ratchet connected to the electric clock system of the plant.

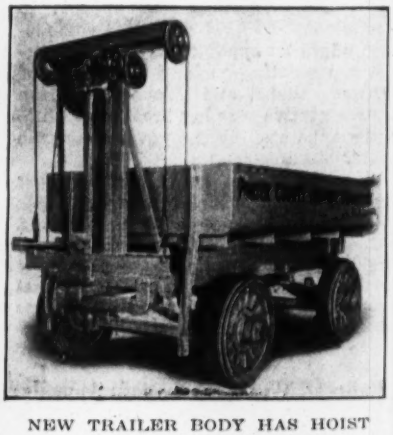


HUGE GRAPHIC POWER METER HAS THIRTY UNITS

The instrument is installed in the bench board in front of the station operator's desk and the indicator and chart are always before him.

End-Dump Hoisting Body Now Made for Trailers

A new type of body for tractor trailers has been brought out by the Archer Iron Works, Western Ave. and 34th Place, Chicago—a 4-yd. steel hopper with rear door, tilted by a 5-ton hand hoist for rear-end dumping. On the front of the trailer frame is a pair of channel columns which carry gears for lifting the rack on a T-frame; on the arms of the T are shears over which



NEW TRAILER BODY HAS HOIST FOR END DUMPING

pass cables fastened to the hoist frame and reaching angles on the front of the body. The outfit is shown in the accompanying view mounted on a Troy trailer. One man, it is claimed, can raise the loaded body to a 45° angle in 2 minutes.